

A SURVEY OF INDIA'S INDUSTRIAL PRODUCTION FOR WAR PURPOSES

**R E P O R T
OF
THE AMERICAN TECHNICAL MISSION TO INDIA**

**Submitted to
THE GOVERNMENT OF INDIA
AND TO
THE GOVERNMENT OF THE UNITED STATES**

सत्यमेव जयते

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AMERICAN TECHNICAL MISSION TO INDIA

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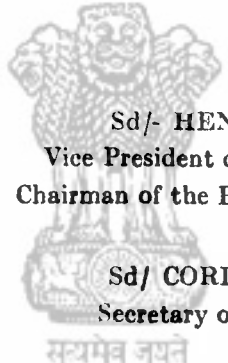


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FOREWORD

Early in 1942 the Government of India invited the Government of the United States to send a group of American experts to India. The purpose of the Mission was to advise the Government of that country on ways and means of stimulating the production in India of essential war materials and to determine how the United States might assist most effectively in this effort. The Government of the United States gladly accepted the invitation. The Department of State, in co-operation with the Board of Economic Warfare, selected the members of the American Technical Mission to India, and issued directives concerning the scope of the Mission's activities. Those appointed were Henry F. Grady, Chairman, H. E. Beyster, Dirk Dekker, A. W. Herrington, and Frank A. Waring, Executive Officer.

The Mission left the United States in April 1942 and returned in June, after making a comprehensive survey of the industrial resources of India and of the possible expansion of production essential to the prosecution of the war. The Mission is now submitting its report, together with its several recommendations. To these recommendations the Government of the United States will give the prompt attention and the thoughtful consideration which the subject so richly merits.



Sd/- HENRY A. WALLACE
Vice President of the United States, and
Chairman of the Board of Economic Warfare

Sd/ CORDELL HULL
Secretary of State

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ACKNOWLEDGMENT

The members of the American Technical Mission wish to express their sincere appreciation for the cordial hospitality extended to them by the Government of India during their recent visit. They feel a pleasant sense of obligation for the many courtesies shown them by officials of that Government. They particularly wish to acknowledge their indebtedness to Mr. E. M. Jenkins, Secretary of the Department of Supply, whose co-operation and assistance were most valuable, and to Lieutenant-Colonel D. G. P. M. Shewen who, as Staff Officer of the Mission, did much to make a rigorous program less difficult and arduous.

The members of the Mission wish also to express their appreciation of the co-operation accorded them by the Government of the United States. They are especially grateful for the assistance received from officers of the Department of State, both at home and abroad, and from officials of the Board of Economic Warfare and of the Lend-Lease Administration.

For much of the factual data contained in this report, the Mission acknowledges its indebtedness to officials of the Department of Supply who prepared a comprehensive series of memoranda covering the principal phases of industrial activity in India, and to officials of the Board of Economic Warfare who, prior to the departure of the Mission, submitted a most helpful report on the economy of India.



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REPORT OF THE AMERICAN TECHNICAL MISSION TO INDIA

INTRODUCTION

The Government of India extended an invitation to the Government of the United States to send to India a group of experts to investigate the industrial resources of that country and to recommend ways and means by which the Government of the United States could assist in augmenting India's war production. The Government of the United States accepted the invitation, and the Secretary of State appointed, as members of the American Technical Mission to India, Dr. Henry F. Grady (Chairman), Mr. Harry E. Beyster, Mr. Dirk Dekker, and Mr. Arthur W. Herrington. Dr. Frank A. Waring was named Executive Officer of the Mission. Because of its terms of reference, the work of the Mission was directly related to the common war effort of the United Nations and was in no way connected with the post-war industrial and commercial problems of India.

The Mission left New York on April 8, 1942, and arrived in New Delhi on April 17. It remained in India 5 weeks, leaving Karachi on May 22 and arriving in Washington on June 2. During its stay in India the Mission conferred with officials of interested Departments of the Government of India and of some of the Provinces and States, and with industrial leaders, businessmen, and chambers of commerce in New Delhi, Calcutta, and Bombay. It visited Government munition factories, railway workshops, shipbuilding and ship-repair shops, and the principal industrial plants engaged in the production of war materials in the Calcutta area. It spent 2 days in inspecting the plants of the Tata Iron and Steel Company and its allied concerns producing steel castings, tin plate, and wire and cable at or near Jamshedpur. It visited the principal industrial plants of Bombay, including those for automobile assembly and the manufacture of tires, and it spent a day in inspecting the port area of that city. The Mission also visited the port area at Karachi and conferred with officials concerning conditions there and at the port of Cochin.

The Mission at all times received the most cordial co-operation from officials of the Government of India, especially those in the Supply Department with whom the members were in daily contact. Mr. Jenkins, Secretary of the Supply Department, was particularly helpful. The members of the Mission were given every opportunity to confer with all types of industrialists, regardless of their political beliefs and affiliations, and to visit any and all industrial plants in which they evidenced an interest.

The members believe that the Mission, by its advice, has been able to suggest much that will be helpful to the Government and industrialists of India and that additional assistance will flow from the fulfillment of its recommendations concerning the supply of materials and personnel to further India's effort to increase its production of munitions and other essential goods. Some of the Mission's recommendations were designed to expedite the orders for equipment placed prior to the Mission's arrival in India. Other orders were placed by the Government of India and endorsed by the Mission after conferences with officials of the Government. In all instances the Mission's endorsement was given only after a careful investigation of the facts pertinent to each case.

The American Technical Mission to India is submitting herewith its report to the Government of India and to the Government of the United States. Before its departure from India the Mission presented to the Government of that country a preliminary report in which it set forth some of its basic recommendations. And, immediately upon its return to the United States, the Mission presented a preliminary report to its own Government. In this final report, the Mission submits in full its recommendations, together with the pertinent factual data that impelled their formulation.

This report is offered in a spirit of constructive suggestion. The Mission is in no sense critical of the efforts which have thus far been made by the Government and the industrialists of India in the development of war production. Much has already been done despite grave handicaps in equipment, materials, and personnel. But today an even greater effort is required. With the enemy at their very gates, the Mission is confident that the Government and people of India will respond to the challenge as did the Government and people of Great Britain after Dunkirk and the Government and people of the United States after Pearl Harbor.

THE STRATEGIC IMPORTANCE OF INDIA

The Mission believes that India is of great strategic importance to the cause of the United Nations. In its opinion this is because India can be utilized as a base for an offensive against the Japanese in Burma, because India and Burma are essential links in the efforts of the United Nations to supply China with war materials, and, finally, because India possesses great natural resources which must not only be kept from the enemy, but must also be fully developed for the benefit of the United Nations. The importance of rapidly developing India's potentialities for war production has been greatly accentuated by recent military developments in south-eastern Asia. At present there appear to be three principal war fronts of the United Nations in their struggle against the aggressors. These are the Soviet Union front, the India-Burma-China front, and the Australian front. The military strength of the front with which India is associated will be largely determined by the extent to which that country, limited only by capacity and practicability, can become an important arsenal producing munitions essential to the prosecution of the war. There is, therefore, not only the problem of producing military equipment to protect India from invasion, but also that of supplying quickly and effectively certain war equipment essential to aggressive action in Burma and China. Current difficulties of transportation may be lessened by an improvement of the military situation, but the time factor will continue to be important. The production of military supplies close to a military front is obviously vital.

It is the opinion of the Mission that a much larger army than now exists can be recruited in India. The capacity of that country to mobilize such an army is a vital consideration in any plan to expand its production of war materials. Indeed, if India can aid the United Nations by supplying equipment and by creating an even more formidable army of its own, it will be of material assistance in bringing about an early and successful termination of the war.

ORGANIZATION OF GOVERNMENT AND INDUSTRY.

At the time of the Mission's visit, the Government of India and the industries of India, with few exceptions, were not organized on a war basis. There was no single governmental official or group of officials with the responsibility of directing and co-ordinating the entire industrial war effort. Competitive bidding was still required in obtaining supplies of many articles. The Mission found horseshoes, steel tips for army boots, and railroad switch gear being produced in a ship-repair plant at Bombay, while more than 100 ships waited

in the harbor for major and minor repairs. A large number of the industrial plants in India were, in fact, mere jobbing shops producing a variety of articles with a resulting loss in efficiency of production; yet there was no central authority to bring about the transfer of machinery and the concentration in production that would be certain to result in increased output. The railroads, despite increasingly serious congestion were accepting goods for shipment with little regard for their importance or ultimate use. There was a shortage in electric power, but no serious attempt was being made to curtail consumption for non-essential purposes. An adequate system of priorities had not been developed and, in consequence, essential construction was frequently delayed by the lack of requisite materials. Prices were increasing, but no machinery had been established for their control.

The industrialists in India were, with few exceptions, still concerned primarily with profits and apparently did not realize the threat which the war had created not only to profits, but to capital as well. Valuable time was lost in debating whether Government or industry should pay for plant extensions and, if government was to pay, the terms on which the property might be acquired when the war was ended. Numerous industrialists were demanding substantial war risk insurance and a guarantee of profits. Protracted negotiations were necessary before some industries would accept government contracts that were less remunerative than production for civilian demand. A number of Indian industrialists were not in sympathy with the Government of India and stubbornly resisted its efforts to take over plants for war production or to requisition and remove machinery urgently required elsewhere. They appeared to be more concerned with possible conditions in the post-war period than with the assistance they might be able to render in the present emergency.

In its preliminary report to the Government of India, the Mission made the following observations concerning the organization of the Government of India and of the industries of India for the increased production of materials essential to the war :

“Political and industrial economy in times of war is very different from that in times of peace. In a democracy there must be a considerable element of *laissez faire* and the profit incentive in the production and distribution of goods is generally recognised. Initiative and enterprise do not thrive under regimentation and yet, under the emergency of war, there must be unification, co-ordination, the restriction of initiative, the subordination of the profit incentive, and the complete concentration of the nation through its government on the defeat of the enemy. Democracies are characteristically slow in converting their national organization from a peacetime to a wartime basis. Totalitarian countries which are always mobilized for national objectives have little difficulty in quickly striking with the full force of their national resources. Some leaders in our country were talking as late as a year ago of ‘business as usual’ and of the ability of the country to do the war job and to continue its normal peacetime activities. Finally, however, we learned that this could not be done and public opinion in government business, agriculture, and labor is now united on the single objective of defending the country and its allies against the aggressors. To accomplish this task it has been necessary greatly to change our government organization. Mr. Donald Nelson has had delegated to him by the President many of the President’s broad war powers. He is in effect the czar of war production. It took the United States many months to evolve the War Production Board and its organization under Mr. Nelson.

Development along similar lines was necessary in Great Britain, Canada, Australia, and in others of the United Nations.

- "The Government of India has made definite progress during the last year in stimulating India's war effort. Indeed, some believe that it has attained its maximum production under a voluntary system actuated by the profit motive, but there is still much to be done before the complete mobilization of India's resources shall have been attained. The United States, Great Britain, and other democratic countries have had a two fold problem, first, that of augmenting the production of certain peace-time commodities needed for war, and secondly, of converting peacetime industries to war production. India has had that same problem. These two phases of reorganizing and co-ordinating long-established institutions can hardly be done without strong centralized power vested in government and exercised by it.
- "In India most of the shops now producing war goods are engineering concerns which historically have been jobbing shops. They have produced a large variety of articles based on the orders received. As the Government of India has issued orders for the production of munitions and other war goods, these shops, including the railroad shops, have taken the orders on a 'jobbing' basis. To maximize production it will be necessary to have a basic change in production technique. It will be necessary to concentrate machinery and plant on one or two rather than many articles. A few plants in India have developed the mass production technique to a high degree of efficiency, notably the Tata plant producing iron and steel, but many more must be induced or compelled to do so.
- "To convert a large number of miscellaneous engineering shops to something approximating the system of 'assembly-line' production common to advanced industrial countries is a difficult undertaking, but it is essential that this be done if India's maximum potentialities for war production are to be realized. It will be necessary not only to obtain new equipment but also to move equipment from one shop to another and thus develop a program of concentrated, rather than scattered effort. In many instances such a reorganization should also include the rearrangement of machinery within existing plants to achieve maximum efficiency.
- "With the more general establishment of plants engaged in war production, the armed forces and the Government of India will have, on a wider scale than heretofore, the problem and responsibility of planning orders sufficiently far in advance to secure and maintain efficiency of operations. It is the opinion of the Mission that beneficial results could be obtained by the immediate and general application of such a policy. In addition, a more rigid control of raw materials and the priority allocation of them will have to be instituted. Price fixing will be required so as to remove unreasonable profits from war production and avoid the disaster of inflation. It is not the intention of the Mission, however, to recommend any particular form of governmental organization to accomplish these purposes. The Mission wishes merely to state the problem and let the Government and leaders of India determine how it can best be solved.
- "The organization of war production in the United States is practically independent of established government agencies. This arrangement has much to commend it, and many who have talked with the

Mission have stated that something comparable to our system, or to that of Great Britain which is similar should be adopted in India. Others have suggested that the Supply Department, which under present conditions has been primarily responsible for war production, should have divorced from it the problems of production and that a new Department of Production under the direction of a member of the Council should be formed. It was urged that, if established, such a department might be strengthened by bringing into it, as heads of departments, executives from industry and that to this organization might be added production advisers from the United States. Still another suggestion is that the Department of supply might be converted into a Department of Production and Supply with two clearly defined divisions, the functions of which would be segregated in accordance with the new title. A fourth suggestion, which appeals to the Mission as being sound and feasible, provides for the establishment of a war cabinet of three or five members of the Council with an appropriate Secretariat, which would have complete control of war production in all its phases. With membership based on responsibility for production, transportation and communication, finance, and defense, such a cabinet might direct the war effort more effectively than could be done under any of the suggestions outlined above."

The members of the Mission have been gratified to learn that the Government of India have accepted its suggestion regarding governmental organization for war production and has established the War Resources Committee of Council which, the Mission understands, is charged with the duty of co-ordinating and directing India's industrial war effort. His Excellency The Viceroy is president of the Committee which consists of the Defence Member, the Supply Member (Vice President), the Commerce Member, the Finance Member, and the Communications Member. The Mission believes that this action, together with the appointment of a permanent Secretary, represents a substantial advance in India's program for the intensification of its industrial production.

The expansion of industrial production in India is to be based at least in part on Lend-Lease material from the United States, and upon the advice of technicians from this country whose services have been requested by the Government of India and whose appointment has been recommended by the Mission. Because of the interest of the United States in the industrial development of India, the Mission believes that the Government of the United States should appoint an Economic Adviser as a member of the staff of the American Mission in New Delhi. The duties of such an appointee would be to direct and co-ordinate, from the standpoint of this country, its various economic activities in India. In addition to representing the Department of State in economic matters, he would act for the Board of Economic Warfare and the Lend-Lease Administration, and would maintain close contact with representatives in India of the United States Army, the Reconstruction Finance Corporation, and the United States Maritime Commission so that he might be apprised of, and might co-operate with, their economic activities. In order that this special representative might work most effectively with appropriate officials of the Government of India, the Mission wishes to suggest that he be fully informed of the activities of the War Resources Committee of Council, and of the various Departments concerned. In this way the Mission believes that the efforts of the two Governments might be most fully and effectively co-ordinated.

Recommendations*

1. The Mission recommends that the necessary authority and responsibility for the industrial program affecting the production of war materials be centralized in an appropriate individual or group within the Government of India.
2. The Mission recommends that the Government of India make every effort to mobilize the industrial resources of that country in order that maximum production of essential war materials can be obtained. To assist in achieving this objective, it suggests that :
 - (a) Wherever appropriate and possible, existing engineering shops that are in reality jobbing shops should be converted into mass production factories ;
 - (b) The Government of India and the military command should make every effort to plan as far as possible in advance its orders of supplies, and the military command should be requested to re-examine its present supply program in the light of current military developments ;
 - (c) The Government of India should exercise more rigid control over raw materials and should adopt a system of priority allocation for their distribution; and
 - (d) To prevent the possible disaster of inflation, the Government of India should take steps to introduce adequate measures of price control.
3. The Mission recommends to the Government of the United States that it appoint an Economic Adviser on the staff of the American Mission in New Delhi who would supervise the economic activities of the United States in India and assist in co-ordinating the programs of the two Governments. It suggests to the Government of India that this special representative be kept fully informed of the activities of the War Resources Committee of Council and of the various Departments concerned.

EASTERN GROUP SUPPLY COUNCIL.

The Eastern Group Supply Council was established in the fall of 1940 to co-ordinate war production and supply in Great Britain, India, Australia, New Zealand, and South Africa. It has accomplished notable results. With current developments in the military situation, however, only India and South Africa have remained able to make active contributions to the Council, and South Africa has not been a large producer of war materials. The clearance through the Council of purchases from the Government of India on behalf of overseas commands, therefore, would seem no longer to serve a useful purpose. Accordingly, the Mission ventures to suggest that orders from overseas placed on India should be handled directly by the Supply Department of the Government of India without prior clearance through the Eastern Group Supply Council. This is not to be interpreted as a recommendation for the discontinuance of the Council. It can continue to serve a useful purpose by assembling and co-ordinating information on production and supply in the various countries making up the Group and by disseminating such information to the proper authorities in those countries.

* In order to facilitate the study of the Mission's report, the pertinent recommendations are set forth at the end of each section.

Recommendations.

1. The Mission recommends that orders from overseas placed on India should be handled directly by the Supply Department of India without prior clearance through the Eastern Group Supply council.
2. It further recommends that the Council be continued as an agency for assembling and co-ordinating information on production and supply for dissemination to the proper authorities in those countries having representation in the Council.

TRANSPORTATION AND COMMUNICATION.

The railway, port, and communication facilities in India have been adversely affected by military developments in recent months. Attacks by the Japanese on shipping in the Bay of Bengal have temporarily immobilized the ports on the east coast of India. This has imposed a greatly increased burden not only on ports of the west coast, notably Bombay, Karachi, and Cochin, but also on inland transportation facilities, especially the railways.

Railways are by far the most important means of transportation in India. Indeed, it is estimated that they carry more than 98 per cent. of all land-borne traffic. Current estimates of the ton-miles borne by railways and roads are as follows :

	<i>Ton-miles</i> (In millions)
Railways	28,000
Roads	450

Government ownership of, and interest in, the railways has doubtless operated to retard the development of other types of transportation. Traffic on the rivers of India might be increased somewhat, but the principal rivers, with few exceptions, are not so located as to relieve the railways of much of their present burden. A substantial program of road construction would, when completed, assist in solving the present problem of transportation in India and should certainly be undertaken promptly. Such a program, however, would not provide immediate relief because of the time required to implement it. Moreover, increased use of roads would stimulate the consumption of rubber and gasoline, of which there is already a shortage. A pipe line across at least a part of India has been suggested to relieve the railways of the recently imposed burden of transporting petroleum from west-coast ports to the Calcutta area. Inasmuch as the total capacity of tank cars in India is inadequate to cope with this single problem, it would appear that the proposal should receive serious consideration, despite the time that would be consumed in its execution. But, even with the development of these various alternate means of transportation, the railways will remain the chief instrument for the movement of goods across India. Their maintenance and improvement, therefore, are matters of special concern.

Railways.

There are 48 railway systems in India. Of these, 13 are class I roads, each having earnings in excess of \$1,500,000 a year; together they control most of the equipment and trackage in the country. At the outbreak of the war the Government of India owned about 75 per cent. and managed about 40 per cent. of the total route mileage of the Indian railways. At present the entire railway system is operated under Government control, which is exercised by a Railway Board in the Department of Communications.

On March 31, 1941, the total route mileage of the Indian railway system was 41,156, more than nine-tenths of which consisted of single lines. The

track mileage of Indian railways was about 56,000, of which 11,000 were sidings. Broad-gage lines (5ft. 6 in.) accounted for 21,154 miles, meter-gage lines (3 ft. 3-3/8 inch) for 15,899 miles, and narrow-gage (2 ft. 6 in. and 2 ft. 0 in.) for 4,103 miles. Broad-gage lines connect all of the important ports of India, except Chittagong, with most, if not all, of the principal industrial centers. Meter-gage lines, which were first introduced many years ago principally for the sake of economy, constitute an important supplementary system and operate chiefly in north-eastern India, in Rajputana, and in the extreme south. The narrow-gage lines operate largely as feeders to the broad-gage systems.

The tractive power of the average locomotive in India is slightly more than one-half of that in the United States. The capacity of the class I broad and meter-gage freight cars, which constitute most of the total stock, was 3,619,094 tons, and the capacity of each car is about 22 tons. On March 31, 1941, the latest date for which detailed statistics are available, the motive power and the rolling stock of the railways in India consisted of the following numbers and types of vehicles :

	<i>Broad-gage</i>	<i>Meter-gage</i>	<i>Narrow-gage</i>
Locomotive ¹	5,290	2,638	558
Passenger cars	13,815	9,841	2,065
Freight cars ²	152,402	59,600	7,232

Since March 31, 1941, the railways of India have lost appreciable numbers of freight cars and locomotives that were sent to assist in the campaign in the Middle East. These include 230 meter-gage locomotives, 6 narrow-gage locomotives, more than 9,000 meter-gage cars of various types, 50 narrow-gage cars, and 2,100 broad-gage cars which were, or are, being converted to standard-gage prior to shipping.

Despite the loss in motive power and rolling stock, the railways of India, in the fiscal year 1941-42, handled an appreciably larger volume of traffic than in the immediately preceding years. In the fiscal year 1940-41 the railways carried 575,723,000 passengers, an increase over the previous year of 8.7 per cent; the passenger miles amounted to 19,933 million which was 7.6 per cent greater than in the previous year. Statistics of the net ton-miles moved over the railways in the last four fiscal years, beginning with 1938-39, are shown in table 1.

Table 1.—Indian railways : Net ton-miles moved,
1938-39 to 1941-42

Year ending March 31	Broad- gage	Percent of increase over 1938-39	Meter- gage	Percent of increase over 1938-39
	<i>1,000 net ton-miles</i>		<i>1,000 net ton-miles</i>	
1938-39 —	18,283,959	—	3,023,616	—
1939-40 —	19,352,820	+ 5.85	3,226,810	+ 6.72
1940-41	21,041,216	+ 15.08	3,367,697	+ 11.38
1941-42* —	23,321,033	+ 27.55	3,650,325	+ 20.73

*Estimated on the basis of operations for 9 months.

Source: Government of India, Department of Communications, Railway Board.

¹ On March 31, 1939, broad-gage locomotives numbered 5,300, and narrow-gage, 2,602.

² On March 31, 1939, broad-gage freight cars numbered 149,131, and meter-gage, 59,090.

It is obvious that such an increase in traffic could be handled only by an improved utilization of the locomotives and rolling stock of the Indian railways. This improvement is reflected in the statistics given in table 2.

Table 2.—Indian railways : Net ton-miles moved per locomotive day and per wagon day, 1938-39 to 1940-41.

Year ending March 31	Broad-gage	Meter-gage
<i>Net ton-miles per locomotive day on line</i>		
1938-39—	15,144	7,019
1939-40—	15,776	7,467
1940-41—	17,154	7,637
<i>Net ton-miles per wagon day</i>		
1938-39—	351	147
1939-40—	367	158
1940-41—	392	163
<i>Engine-miles per day per engine on line</i>		
1938-39—	79	76
1939-40—	81	78
1940-41—	83	77
<i>Wagon-miles per wagon day</i>		
1938-39—	40.2	30.9
1939-40—	41.3	32.9
1940-41—	42.9	33.1

Source : Railway Board, Department of Communications Government of India.

Despite the advance thus far made in the utilization of motive power and rolling stock, the Mission is of the opinion that further improvement can be effected, and indeed must be, if the railways of India are to perform the task of transportation essential to the prosecution of the war. The railways are now seriously overburdened, and evidences of an actual break-down are becoming increasingly apparent. Finished goods at steel mills and other plants are accumulating for want of transportation, and inventories of essential raw materials are declining below the danger point because incoming shipments are not keeping pace with requirements. This conditions is due to a number of factors, among the most important of which are the following :

1. *The closing of the east-coast ports by enemy action in the Bay of Bengal.* — Of the seven principal ports of India, four (Madras, Vizagapatam, Calcutta, and Chittagong) are located on the east coast. These four ports, which in 1941 handled approximately 11,000,000 tons, or about one-half of the total ocean-borne traffic of India, were at the time of the Mission's visit almost totally inactive because of the presence of the Japanese in the Bay of Bengal. All essential exports from these ports, formerly carried directly by sea, had to be transported across India by rail before they could be loaded on ocean-going vessels. This placed a tremendous additional burden on the railroads, particularly in the Calcutta area, which alone customarily accounted for about 9,000,000 tons of ocean-borne traffic. Among the principal products now requiring rail transportation are coal, jute and jute products, pig iron, manganese, and tea. These commodities, together with

a few other strategic ones such as linsced, mica, and shellac, aggregate nearly 4,000,000 tons annually; their movement from Calcutta to Bombay would necessitate the daily allocation of about 700 railway cars. Imported products also present a serious problem. Approximately 1,650 tank cars are required to provide the quantity of petroleum products necessary for the Calcutta district, and the stock of tank cars in all India is only 1,500. In addition, there is the problem of providing railway transportation for the various foodstuffs formerly imported into Calcutta. Inasmuch as the Calcutta district accounts for about two-thirds of the industrial activity of India, the maintenance of a flow of essential traffic to and from that area assumes a special importance.

2. The increased traffic arising out of the greater industrial production caused by the war.—As in most countries involved in the war, industrial activity in India has been stimulated and general employment and purchasing power have been increased. This has been reflected in a greater movement of passengers and traffic over the railroads. Moreover, the enlarged demand upon the railroads has operated to prevent the accumulation at plant sites of inventories of essential raw materials, such as coal and iron ore, during seasons of off-peak traffic.

3. The greatly increased movement of troops and military supplies.

4. The loss of rolling stock and locomotives sent to assist in the campaign in the Middle East.

Ordinarily 1,500 freight cars are built each year in the railway workshops of India, but the railways are now 1 year in arrears on this program, in part because of their inability to obtain essential equipment from the United Kingdom. The Tata Iron and Steel Company, however, has recently installed a wheel and axle plant which should relieve a part of this difficulty.

Broad-gage locomotives are not built in India, the essential facilities for such construction not being available there. Orders placed in the United Kingdom have been long delayed; at present, delivery is awaited on 66 locomotives and the number would have been much greater had not additional orders been prohibited. Broad-gage locomotives are urgently required. When the war began (1939), 574 engines were awaiting renewal, based on a life of 35 years, by 1945, 1,495 broad-gage locomotives, or 29 per cent. of the total stock as of March 31, 1941, will be in need of replacement after allowing for the 66 on order.

The construction in India of 10 to 15 meter-gage locomotives per annum has been carried on for some time. This program, however, is inadequate to meet requirements. At the outbreak of the war 366 meter-gage locomotives were due for replacement after 35 years of service, and by 1945 this number will have increased to 829, or 35 per cent. of the total stock as of March 31, 1941.

Despite the loss of four railroad workshops to the Government for the production of munitions, officials of the Government of India state that the repair of rolling stock and locomotives has been adequately maintained. The unusual demand for equipment, however, has kept the rolling stock and locomotives in use when they would ordinarily be returned to the shops for repair. Efforts have been made to reduce to a minimum the number of locomotives and cars under repair. The goal for locomotives, for example, is no more than 12 per cent. of the total. The average time required for the periodic overhaul of locomotives in the main workshops was, in March 1942, 37 days for broad-gage locomotives and 35 days for meter-gage; the corresponding pre-war figures were 40 days and 32 days,

respectively. The average time required for the overhaul of freight cars in March 1942 was 6·7 days for broad-gage cars and 8·9 days for meter-gage cars; the corresponding figures for the months immediately preceding the outbreak of war were 7·4 and 8·9 days, respectively¹. A statement of the rolling stock on Indian railways out of service for repair is given in table 3.

Table 3.—Rolling stock of Indian railways out of service for repair, pre-war and current.

Period	Broad-gage		Meter-gage	
	Number	Percent of total	Number	Percent of total
Locomotives				
Sept.-Nov. 1938—	979	18·5	302	13·0
Sept.-Nov. 1941—	833	15·7	310	13·6
Dec. 1938, Jan.-Feb. 1939—	965	18·0	277	12·0
Dec. 1941, Jan.-Feb. 1942—	850	16·0	264	11·1
March-May 1939—	969	18·3	293	12·6
March-May 1941—	898	17·0	293	12·4
June-Aug. 1939—	904	18·8	324	14·0
June-Aug. 1941—	903	17·1	322	13·6
Freight cars				
Sept.-Nov. 1938—	8,297	5·4	1,596	2·9
Sept.-Nov. 1941—	6,831	4·3	1,786	3·2
Dec. 1938, Jan.-Feb. 1939—	7,128	4·6	1,663	3·0
Dec. 1941, Jan.-Feb. 1942—	5,840	3·7	1,629	2·9
March-May 1939—	8,249	5·3	2,038	3·7
March-May 1941—	6,612	3·5	1,955	3·5
June-Aug. 1939—	8,688	5·6	2,115	3·8
June-Aug. 1941—	6,994	4·5	1,951	3·5

Source : Government of India, Department of Communications, Railway Board.

Ports

Prior to the outbreak of the war India ranked about tenth among the trading nations of the world. Its position was probably higher in 1941-42. The total foreign commerce in India has aggregated approximately 22,000,000 tons, which were divided about equally between imports and exports. Although India has an extensive coast line with many ports, only a few are considered suitable for use throughout the year. Seven ports account for more

¹ In all cases the average number of days in shops includes Sundays and holidays.

than 75 percent of India's total foreign trade. These ports are Karachi, Bombay, Cochin, Madras, Vizagapatam, Calcutta, and Chittagong, of which only the west-coast ports (Karachi, Bombay, and Cochin) have natural harbors.

The closing of the east-coast ports by enemy action in the Bay of Bengal has thrown a tremendous burden on the west-coast ports which must now handle all of the ocean-borne traffic entering and leaving India, whereas prior to 1942 they had accounted for less than one-half of the total. The congestion of shipping at Karachi, Bombay, and Cochin has become acute, and there is confusion in moving cargoes to and from the docks. The congestion at Karachi and Cochin, though pronounced, is less serious than at Bombay, now the principal port of India. On May 20, 1942, there were more than 200 ships waiting in the harbor of Bombay to discharge cargo or to obtain needed repairs, and the average turn-around of ships was reported to approximate 6 weeks. In view of the current shortage of shipping and its importance to the United Nations, the Mission deems it vital that harbor facilities in the west-coast ports of India for unloading and repair be improved as rapidly as possible.

Port facilities at Karachi and Cochin are inadequate to handle the sharp increase in the traffic which occurred in the first 6 months of 1942. Port officials discussed with the Mission the additional equipment urgently required to permit them to cope with the increased tonnages, and the Mission agreed to support orders for such equipment when they had been cleared through the Supply Department, and placed on the Lend-Lease Administration by the Indian Purchasing Mission.

The port of Bombay is administered by the Bombay Port Trust, a separate public body created by and operated under the control of the Communications Department of the Government of India. The Port Trust operates as a commercial organization as well as a public service body in managing the various facilities of the port. These include three wet docks with 4.42 miles of quays and a total water area of 104.52 acres. In addition, the Trust controls deep-water tidal berths at three places, two drydocks, 121.8 miles of railway, and 8.12 miles of wharves and bunders used by coastal sailing vessels. The total port area comprises 1,880 acres. The facilities of the port were used in the fiscal year 1941 to handle a monthly average of 419,420 tons of cargo in the entire port area. Of this amount, 245,000 tons, or slightly more than one-half, were loaded or discharged at the docks. The remainder represented cargoes taken from or to ships anchored in the outer harbor or tied at the bunders. The three wet docks together have berths for approximately 45 vessels. The Alexandra Dock, the newest and largest of the three, can berth 17 vessels drawing 32 feet and not exceeding in length 475 feet. The Victoria Dock can handle 14 ships with a draft of 24 feet and not exceeding 430 feet in length. Prince's Dock, the oldest of the three, has seven cargo berths and seven repair berths; it can handle ships which draw 20 feet and which do not exceed 400 feet in length. There are deep-water tidal berths at Ballard pier and along the Alexandra Dock harbor wall. The berth at the Ballard pier is 800 feet long and 30 feet deep, and that at the Alexandra Dock harbor wall, 1,692 feet long and 25 feet deep. There is also a berth at Pir Pau which is 570 feet long and 29 feet deep, and which is used principally for tankers.

In addition to its docking facilities, the Bombay port Trust operates two drydocks, one of which is 1,000 feet long, 100 feet wide, with a 22 foot sill, and a normal depth of water over the sill of 33 feet; the other is 525 feet long, 65½ feet wide, and has 22 feet of water over the 14 foot sill. There are also two private docks in Bombay, one 495 feet long and 66 feet wide, and the other

400 feet long and 66½ feet wide. The Royal Indian Navy operates three drydocks, the maximum lengths of which are 640 feet, 380 feet, and 256 feet, respectively. There are three private companies engaged in shipbuilding and ship repairing in Bombay. At the time of the Mission's visit (May 1942), no ship-repair work was being done by the workshops of the port Trust.

The equipment for the loading, unloading, and repair of ships at Bombay, while adequate under ordinary circumstances, has proved totally inadequate to cope with the recent tremendous increase in traffic. Prompt and drastic steps must be taken if the materials essential to the United Nations are to be moved in and out of India. The Mission, therefore, has made a number of recommendations designed to facilitate the handling of cargo and the repair of ships at Bombay.

Roads, airways, and waterways.

Roads.—On March 31, 1939 there were 319,000 miles of roads in India. Of these 99,000 miles were classified as unsuitable for motor vehicles, 122,000 miles as fair-weather roads, and 98,000 miles as all-weather roads. Of the last-named group, 66,000 miles were water-bound macadam and 32,000 miles were asphalt. Most of the macadam roads are in the provinces of Madras, Bombay, and the United Provinces. The asphalt roads are chiefly in the Indian States of Mysore, Hyderabad, and Travancore. Bengal, Bihar, the Punjab, and the United Provinces have the greatest mileage of fair-weather roads.

The four principal highways in India are the trunk roads which extend from Calcutta to the Khyber, from Calcutta to Madras, from Madras to Bombay, and from Bombay to Delhi. These through-roads parallel the railways as do other main roads in the country. They are far less important, however, than the railways in the movement of commodities and people. In general, it may be said that India's roads are inadequate for the peacetime requirements of the country; they are altogether inadequate for wartime requirements.

The total number of motor vehicles registered in India on January 1941 was 123,400, of which 77,000 were passenger cars, 26,200 were busses, 18,800 were trucks, and 1,400 were diesel units. Additional motor vehicles are, of course, being operated by the armed forces in India, but no data are available concerning their number. The Army, however, has requisitioned 3,700 new vehicles imported for civilian use and 1,800 used vehicles in the 2 years ending June 1942. In addition, a number of trucks have been hired by the Army for the training of drivers, and many more are being used in the construction of roads, airports, army camps, and supply depots. To maintain the present capacity of busses and trucks, already insufficient, at least 10,000 vehicles would have to be imported. The importation of replacement parts is also essential to the maintenance of this traffic. It is possible, of course, that commercial transportation by motor vehicles will be further curtailed by shortage of gasoline and tires.

Airways.—Air transportation has not been greatly developed in India. Only two companies operate regular service between important centers of population. Tata Sons, Limited., the more important of the two companies, maintains services over the three following routes:

(1) Karachi, Bhuj, Ahmedabad, Bombay, Hyderabad, Madras, Trichinopoly, and Colombo; (2) Bombay, Indore, Bhopal, Gwalior, and Delhi; and (3) Bombay, Goa, Cannanore, Trivandrum, and Trichinopoly. The total mileage of these routes is 3,791. The other company, the Indian National Airways, operates between Karachi and Calcutta via Jacobabad, Multan, Lahore, Delhi, Cawnpore, and Allahabad. The service maintained by these two companies

are almost exclusively for passengers and mail; very little freight is transported by air. Although there are a large number of airports in India, many of them are small, with inadequate runways. In fact, few airports in India have runways sufficiently long and reinforced to permit their use by United States "flying fortresses" and other heavy aircraft.

Waterways.— Inland waterways are of importance in the provinces of Bengal, Bihar, Assam, and in parts of Madras. Although no data are immediately available concerning the volume of traffic, steamers and small river boats operate on the river systems of these areas, carrying sugar, grains, and molasses from the Ganges Basin, tea and jute from East Bengal, and tea from Brahmaputra and Surma valleys in Assam to urban centers. With the exception of a few companies operating steamers on rivers in the provinces of Bengal and Assam, transportation on inland waterways is unorganized, and individual boat owners predominate.

Communications.— The postal and telegraph services of India are controlled by the Director-General of Posts and Telegraphs whose office is attached to the Department of Communications. The telegraph facilities of India have been extended considerably in recent years and facilities are now available in all of the larger cities. On March 8, 1938, there were 101,068 miles of line, including cable, and 618,605 miles of wire in India; 257 departmental telegraph offices and 4,053 other telegraph offices were operated by the post office. On the same date there were 463 telephone exchanges in India and about 80,000 telephones. Since 1927 India has been connected by wire-less with the United Kingdom and that service has since been expanded to meet the wireless requirements of aircraft and shipping. In 1933 radio-telephone service between India and the United Kingdom was inaugurated, and this service which was at first restricted to Bombay has now been expanded to include all of the important cities in India. Despite the extension of these various services the Mission found that war demands had placed a severe burden upon them. As a result, it is frequently impossible to transmit messages quickly by either phone or telegraph. Indeed, it was not unusual for mailed confirmations of telegraphic orders to arrive before the orders themselves.

Recommendations.

1. Because of the seriousness of the problem of rail transportation in India, the Mission believes that efforts should be made to secure additional broad-gage locomotives and to increase the production in India of meter-gage locomotives and of freight cars and other essential rolling stock.
2. The Mission has urged the most efficient possible use of available equipment, including a quicker "turn-around" for cars and the possible utilization of third-class passenger cars for freight.
3. It suggests that serious consideration should be given to the installation of a pipe line from Bombay to Calcutta or to some central point, such as Allahabad, for the transportation of petroleum products, and that provision should be made for the manufacture of the pipe in India.
4. It approved a 50 percent curtailment in passenger traffic and suggested the possibility of a further reduction.
5. And it recommended that three top-ranking railway executives from the United States be sent to India to assist in obtaining maximum efficiency in operations.
6. The Mission recommended a substantial increase in the utilization of bunders (rock-walled jetties) for the loading and unloading of

ships in the outer harbor. For this purpose it recommended the construction in India of a large number of barges and tugs, and agreed to endorse orders by the Government of India placed on the Lend-Lease Administration for the motors that would be required for the tugs. It approved the construction of temporary storage sheds and of spur tracks on the bunders in order to facilitate the loading and unloading of the barges or lighters. And it agreed to use its influence to secure from the United States an adequate number of mobile cranes for this work.

7. To secure the maximum utilization of existing equipment at the regular docks, the Mission strongly advocates continuous operation in three 8-hour shifts.* It recommends that the penalties charged for work at night and on Sundays and holidays be abolished.† In their stead, it suggests the imposition of progressive penalties if export cargoes are not available on the docks so that loading operations may be commenced as soon as the unloading of the ship is completed.
8. The Mission does not approve the practice of sending negotiable bills of lading by ships following the actual cargo which such bills cover, and suggests that, inasmuch as this practice has often caused considerable delay in clearing cargoes, the negotiable bills of lading should accompany the cargoes to which they pertain, or be despatched via air mail.
9. The Mission was disturbed to find that ships were leaving the harbor of Bombay with inadequate fuel and water supplies because the facilities there could not provide promptly the necessary quantities. It recommends, therefore, that these facilities be expanded as rapidly as possible.
10. The Mission was informed of, and indeed saw for itself, the congestion of cargoes on the docks of Bombay. It urges that every effort be made to clear promptly these cargoes by rail; should this prove impossible, it suggests that cargoes be removed by motor truck to temporary storage.
11. Because of the congestion at the port of Bombay, the Mission recommends that full consideration be given to the utilization of other west-coast ports. It is ready to support orders for essential equipment at the ports of Karachi and Cochin when approved by the Department of Supply. It wishes also to call the attention of the Government of India to the Kathiawar ports, the facilities of which, it understands, are not now being fully employed.
12. The Mission recommends that an expert be sent from the United States to advise the Government of India on the improvement of harbor facilities in the west coast ports in order that the congestion there may be relieved.

*At the time of the Mission's visit, a day shift was working from 8:00 to 12:30 and from 1:30 to 6:00, and a night shift from 7:30 to 3:30. The Mission was informed that the cargoes were rarely worked for the full 17 hours.

†At the time of the Mission's visit, only two entrance gates to the Alexandra Dock and two to Victoria Dock were kept open between 6:00 p. m. and 6:00 a. m. unless a special customs fee was paid for additional facilities. For each railway gate that was opened on Sundays or holidays, a customs charge of 200 rupees was made. If cargo was to be loaded or unload on Sundays or holidays, a fee of 300 rupees was charged by the Port Trust and an additional fee of 200 rupees by the customs. These fees operated to retard the most efficient utilization of port facilities.

13. Although the construction of additional all-weather roads in India may not be immediate assistance in solving the acute problem of commercial transportation, the Mission believes that such roads would be of great military importance and value. It recommends, therefore, that a program of road building should be undertaken without delay, and is ready to assist in obtaining for the Government of India the requisite equipment.
14. The Mission recommends the expansion and adequate equipment of airports in India, particularly those strategically located for both offensive and defensive operations.
15. The Mission recommends that efforts be made to stimulate the transportation of materials by inland waterways. It particularly urges the use of waterways, where practicable, to relieve the railroads in the movement of bulk freight, such as coal, to and from Calcutta.
16. The Mission recommends that the Government of India undertake a survey of its telephone and telegraph systems in order to ascertain what steps need be taken to improve these services.

PETROLEUM.

Most of the petroleum resources of India are located in the Attock field in the Punjab and the Digboi field in Assam which produce, annually, 30,000,000 gallons and 66,000,000 gallons, respectively. This production is small in relation to India's needs, constituting about 15 per cent of ordinary requirements, excluding the demand from China and that arising out of the increased activity of the air and other military forces in India. Most of the petroleum requirements of India have, in the past, been supplied by Burma, the Netherlands Indies, and Iran; although substantial quantities of lubricating oil were imported from the United States. The loss of Burma and the Netherlands Indies has placed India in the difficult position of having to import large quantities of petroleum products principally from the United States. A substantial part of its needs, however, can be obtained from the Persian Gulf ports of Bahrein and Abadan. Imports which must be greatly increased are now controlled by the Petroleum Department in London, but the Government of India assumes that future supplies will be forthcoming from either the Persian Gulf or the United States.

There are two refineries in India. One is located at Digboi, Assam, and has a daily capacity of 6,500 barrels; it is operated by the Burmah Oil Company which is affiliated with the Anglo-Iranian Oil Company. The other refinery is situated at Rawalpindi, Punjab it has a daily capacity of 4,000 barrels, and is operated by the Attock Oil Company. These two refineries have a daily cracking capacity of 2,100 barrels each and are equipped to produce 70-octane to 80-octane gasoline.

Estimates of probable future consumption of petroleum products in India were given in a memorandum submitted to the Mission by the Government of India. A part of this memorandum is reproduced below.

" Estimated consumption, where possible, with brief comments is given here for the different main products. Figures are collated in table 4.

" A. *Kerosene*. Almost entirely used as an illuminant. No rationing measures at present in force, but bulk rationing can be introduced at very short notice.

White	550,000 tons a year
Red	280,000 " " "

" **B. Motor Spirit.** Civil consumption rationed and now cut by about 43% of pre-rationing figure. At present rates consumption is roughly 180,000 tons a year of which 24,000 tons only would be used in private cars.

" Military consumption is at present at the rate of 68,000 tons a year but how this figure will alter must depend on operational needs of which we have no figures at the moment.

" **C. Aviation Spirit.** There is no indigenous source of 100 O. N. base (from which alone 100 O. N. spirit can be made) and our requirements must come either from Abadan or the U.S.A. 87 O. N. and 90 O. N. spirits blended from indigenous bases require T.E.L. and 90 O. N. 100 O.N. base as well. We may be able to use a certain proportion of indigenous benzol for blending 90 O. N. spirit in part replacement of 100 O. N. base; this is being investigated.

" A separate statement of possible aviation spirit requirements is submitted in table 5.

" **D. Fuel oils.** (i) *Furnace oil.* Consumption may be divided between;

Industrial—roughly 350,000 tons a year largely by Bombay Textiles Industry.

Bunkers—figure impossible to estimate accurately but may go as high as 400,000 or 500,000 tons in 1942.
No rationing in force, but all deliveries controlled.

(ii) *Diesel oils.* Consumption may be divided between :

Industrial—300,000 tons a year.

Bunkers—impossible to estimate but may increase to 100,000 tons a year.

(iii) *Gas oil.* Consumption small at about 20,000 tons a year.

" **E. Jute batching oil.** Consumption depends basically on working hours of East India Jute Mills, but normal consumption, on whatever working hours basis, is susceptible to a cut of 50% in extreme emergency and is already cut by 25%. Consumption between 60,000 and 100,000 tons a year.

" **F. Lubricants.** With the loss of Burma practically all requirements must now come from the U.S.A. Military consumption is now estimated for 1942 at 54,000 tons including Iraq maintenance. Civil consumption is roughly 90,000 tons a year. Castor oil now largely used for railway axle lubrication and use of vegetable oil blends for industrial purposes on large scale likely in near future. Stocks under indirect government control."

Table 4.—Petroleum products: estimated annual consumption in India¹
(In long tons).

Products.								Quantity.
Kerosene :								
White	...	...	...	...	...	...	...	550,000
Red	...	...	...	...	...	...	...	280,000
Motor gasoline								
Civil	...	...	...	...	...	...	...	180,000
Military	...	...	...	...	...	...	...	68,000
Fuel oils :								
Furnace :		Bunkers	...	...	...	...	...	300,000/500,000
		Industrial	...	...	...	...	...	350,000
Diesel :		Bunkers	...	...	...	...	...	100,000
		Industrial	...	...	...	...	...	300,000
Gas oil	...	...	...	...	...	...	...	20,000
Jute batching oil	...	...	...	...	...	...	...	80,000
Lubricants :								
Civil	...	...	...	...	...	...	...	90,000
Military	...	...	...	...	...	...	...	54,000

¹ Excluding aviation gasoline and lubricants for which see table 3.

Source : Department of Supply, Government of India.

Table 5.—Aviation gasoline and lubricants: estimates of India's possible
maximum requirements by the end of 1942¹
(In imperial gallons per month).

						Gasoline Other Grades.	Total.
						100 O. N.	
R. A. F.	...	...	...	...	...	2,875,000	925,000 3,800,000
U. S. transport	...	...	...	...	...	225,000	900,000 1,125,000
U. S. ferry, etc....	...	...	...	...	...	1,090,000	... 1,090,000
R. I. N.	...	...	...	...	...	...	125,000 125,000
Total						4,190,000	1,950,000 6,140,000

PLUS

U. S. Army Air Corps	...	...	...	...	...	Not yet known.	
China	...	...	...	...	...	Up to 1,000,000 grades not known.	

Lubricants.

						100 Viscosity.	120 Viscosity.	Total.
R. A. F.	...	...	...	...	...	127,000	68,000	190,000
U. S. transport	...	...	...	...	...	...	56,000	56,000
U. S. ferry, etc....	...	...	...	...	...	...	54,000	54,000
Total						127,000	178,000	300,000

¹ Estimates prepared in General Headquarters.

Source : Department of Supply, Government of India

Exploration for petroleum.

A moratorium on all prospecting in India was imposed at the instance of the United Kingdom in September 1940. Since then, various sources of supply for petroleum have been lost to the United Nations, and it now appears desirable to develop further the fields in India. Should prospecting be resumed, however, the Government of India has stated that assistance would be required from the United States, or elsewhere, in the provision of technical personnel, prospecting equipment, and ultimately of equipment for refineries.

Industrial alcohol

Industrial alcohol can be produced in India from molasses, now a waste by product of the sugar industry. Two plants for the manufacture of industrial alcohol, having an annual capacity of 750,000 gallons each, are already on order in the United States, and the Government of India wishes to place orders for 10 additional plants of comparable capacities. In view of the greatly increased demand in India for petroleum products, including motor fuel, it would seem desirable to stimulate the production of industrial alcohol and thus conserve petroleum, refining capacity, and shipping space.

Drum containers.

A further problem pertaining to petroleum products in India is that of containers necessary for the transportation and storage of such products. The production of 5-gallon tin containers is adequate to meet Indian requirements. The Government of India, however, has estimated that additional drum-making equipment capable of producing 80,000 drums a month will be required to meet the increased demands of the armed forces of India, the United States, and China.

Recommendations.

1. The Mission assumes that arrangements have been made through the Petroleum Department in London to secure for India its requirements of petroleum and petroleum products. Should the Government of India fail to receive adequate supplies to meet military and essential civilian demands, the Mission agrees to lend its assistance.
2. To insure the receipt in India of adequate supplies of aviation gasoline (100-octane) and for other strategic reasons, the Mission has recommended that a refinery be established at Bahrein to augment the quantities now being made available at Abadan.
3. The Mission recommends that the exploration of potential petroleum fields in India be resumed, and is ready to assist the Government of India in obtaining needed supplies and personnel.
4. The Mission recommends that the material and equipment required for the construction of 12 plants for the production of industrial alcohol be made available to the Government of India under provisions of the Lend-Lease Act.
5. The Mission recommends that the necessary equipment for the manufacture of 80,000 drums a month be made available to the Government of India under the provisions of the Lend-Lease Act.

ELECTRIC POWER.

India's electric power is produced almost entirely to meet industrial demands. The proportion of the total load consumed in buildings and private homes is quite small. Much of India's electrical generating capacity is owned by private utilities, Provincial and State Governments, and municipalities,

although a number of industrial concerns own and operate plants producing electrical energy for their consumption alone. The investment in all these plants amounts to about \$800,000,000 and their annual capacity to about 2,700 million kilowatts.

The distribution of electrical generating plants in India is uneven, being concentrated in the principal industrial centres and in the port cities. The productive capacities of these plants in kilowatts are indicated below by principal districts.

<i>Province or State.</i>	<i>Capacity (kilowatts)¹.</i>
Bengal	² 366,000
Bombay	³ 310,000
United Provinces	⁴ 140,000
Madras	⁵ 129,000
Bihar	⁶ 111,000
Punjab	97,000
Mysore State	61,000
Delhi	31,000

The Provinces of Bengal and Bombay, in which are located the largest ports and industrial centres of the country, are by far the leading producers of electric power. Because of their location and previous industrial development, these two provinces have also been the centres of most of the expansion of war industries. As a result the shortage of generating plants is more acute in these two Provinces than elsewhere. Except for Cawnpore and the Presidency of Madras, however, there is very little reserve power in any of the provinces or States of India. Power, therefore, must be a prime consideration in any program involving either the movement of existing industries or the establishment of new industries.

To prevent the consumption of electrical equipment and wire for non-essential purposes, and to conserve surplus generating capacity, governmental control has been established over all generating and distributing systems in India. This control is exercised by a new agency known as the Central Electric Power Control Board, of which the Electrical Commissioner is a member. Shortly after its creation the Board issued orders to all utilities in India, prohibiting any new service connections that are not essential for war needs.

The Government of India anticipates the installation of a number of extensions to plant capacities in electrical utilities by the middle of 1943. From orders already placed for generators it is expected that 12, with capacities aggregating 40,750 kilowatts, will reach India before the end of 1942 and will be in operation a few months thereafter. Most of this equipment, however, is designed to meet over loaded conditions in the various utilities by which it was ordered. A project to expand the Tata Hydroelectric System in the Bombay area will provide about 16,000 kilowatts of firm peak capacity and about 130,000,000 kilowatts annually, but most of this power will be required to meet the increased demands of existing consumers, including the railways. There is also a project designed to increase the production of electrical energy

¹ The capacities of self-contained factories are not included, except as noted.

² Of this amount 289,000 kilowatts are in the Calcutta area and 26,000 are at the Steel Corporation of Bengal.

³ Principally the port area and city of Bombay, including railways.

⁴ Of this amount 43,000 kilowatts are in the city of Madras.

⁵ Of this amount 64,000 kilowatts are in Cawnpore.

⁶ Of this amount 80,000 kilowatts are produced by the Tata Iron and Steel Company. Ltd.

at Jog Falls, in Mysore, by 48,000 kilowatts. This additional capacity will be fully utilized by the new plants that are now being installed there for the production of war materials. It is essential, therefore, that this project be completed promptly.

Recommendations.

1. The Mission recommends that the projects for the expansion of the production of electrical energy in Bombay and Mysore be completed as rapidly as possible and that every effort be made to expedite the delivery of other electrical generating equipment now on order.
2. The Mission recommends that, whenever the demand of war industries for electrical power exceeds the supply, the Central Electric Power Control Board should curtail the services extended to nonessential consumers or to consumers which are not in a position to utilize the total load customarily made available to them. The jute mills, for example, operating at very much less than capacity. In the Calcutta area a substantial saving of power could be effected by concentrating production in those jute mills necessary to supply current demands and by closing the others.
3. The Mission is of the opinion that for a long-term program, attention should be given to the development of hydroelectric power. But, inasmuch as the completion of most projects of this nature would require several years, the Mission does not believe that they should be considered as a part of any program to increase the production of war materials in India. In fact, the Mission recommends that the launching of any substantial hydroelectric projects be delayed until the war is ended. Meanwhile, to provide the power necessary for the expansion of Indian industry, the Mission suggests the installation of steam or diesel plants for the generation of electrical energy.

IRON AND STEEL

Steel is basic to industrial production of almost every kind. The steel industry, therefore, is a key industry and the production of steel is often regarded as an index of a country's general industrial production. India is fortunate in having an efficiently operated steel industry and in having within its own borders all of the raw materials essential to the manufacture of steel. Its deposits of iron ore are high-grade and very large. Its deposits of coal are adequate to support for many years a much bigger steel industry than the present one, and its deposits of manganese ore much more than adequate for that purpose*.

Iron ore.

India is the second largest producer of iron ore in the British Empire, being exceeded only by the United Kingdom. About 8,000,000 tons of iron ore are mined annually in India. Mining operations are centered chiefly in the Singhbhum district of Bihar, and in nearby States; small quantities are also mined in Mysore State. Almost all of the Iron ore mined in India is sent to iron works within the country for smelting, but in past years substantial quantities were exported to Japan. Exports from India are now chiefly in the form of pig iron and amount to about 500,000 tons annually, all of which are shipped to the United Kingdom.

The reserves of iron ore in India are probably the largest in the world and are superior in quality to those of any other country. In the Singhbhum

* See section on Nonferrous metals, Manganese ore.

district alone the reserves of iron ore with an iron content in excess of 60 per cent are estimated at not less than 3,000 million tons and may amount to as much as 20,000 million tons. In Baster State the reserves are estimated at 724,000,000 tons of high-quality ore. There are also important deposits in neighboring districts of the Central Provinces, one of which in the Rajhana Hills is estimated to contain 2,500,000 tons of ore with a 67½ per cent iron content.

The quantity of iron ore mined in India in recent years is shown in table 6, together with the quantity of pig iron produced therefrom and the quantity of steel produced from the pig iron devoted to that purpose.

Table 6.—Production of iron ore, pig iron, and steel, in India, 1937-40.

(In thousands of tons)

Year.	Iron ore.	Pig iron.	Pig iron used in steel production.	Steel.
1937	2,871	1,621	802	665
1938	2,744	1,540	852	693
1939	3,166	1,757	893	742
1940	3,103	1,994	1,094	934

Source : Department of Supply, Government of India.

Coal and Coke.

The coal resources in Bengal and Bihar have been estimated at 60 billion tons, of which 20 billion are considered workable, and reserves in the Central Provinces and Berar have been estimated at 17 billion tons, of which 5,150 million are considered workable. In addition, there are coal resources ranging from 60 million to 80 million tons in the Langrin plateau of Assam, and 70 million tons in Nongstoin. Reserves of coal suitable for the manufacture of metallurgical coke have been estimated at 500 million tons, of which approximately one-half will be lost in the process of mining under existing methods; these reserves are being consumed at the annual rate of about 15 million tons, and are being used largely for purposes other than the manufacture of coke. Should the reserves of coal suitable for coke be devoted exclusively to that purpose, they would last for many years, even though the production of iron and steel should be greatly increased. The coking coal of India, although satisfactory for smelting purposes, is not of the best quality, having a substantial ash residue.

The total production of coal in India has ranged from 25 million tons in 1937 to 29 million tons in 1940. Exports of coal from India in recent years have amounted to about 2 million tons. Table 7 shows the annual production of coal in India, together with the amounts used for the manufacture of coke and the quantity of coke produced therefrom.

Table 7.—Production of coal and coke in India, 1937-40.

(In thousands of tons)

Year.	Coal.	Coal used for coke making.	Coke.
1937	25,036	2,688	1,867
1938	28,343	2,898	1,711
1939	27,769	2,694	1,917
1940	29,888	2,985	2,109

Source : Department of Supply, Government of India.

Iron and steel industry.

Production.—The annual production of pig iron in India rose from 1,750,000 tons in 1939 to 2,000,000 tons in 1942. Modifications in existing furnaces may further increase production to 2,100,000 in 1943. Of this amount, it was planned that about 500,000 tons would be exported to the United Kingdom, 100,000 tons would be used in the Iron foundries of India, and the remainder would be consumed in the production of steel. Prior to the war the total annual output of finished steel in India was 750,000 tons. Since then, plant capacity and annual production have been increased; in 1942 production was at the annual rate of 1,200,000 tons. And this may be increased to 1,500,000 tons by projects for the expansion of plant capacities now under consideration.

Producing companies. The Tata Iron and Steel Company, located at Jamshedpur about 150 miles west of Calcutta, accounts for approximately 75 percent of the total production of steel in India. It is reported to be the largest single steel plant in the British Empire. The plant is equipped with modern machinery which is efficiently operated. The Steel Corporation of Bengal has the second largest plant in India and accounts for about 17 percent of that country's production. It, too, is equipped with modern and efficient machinery. The Government Metal and Steel Factory at Ishapore is the third largest steel plant in the country, but produces only high-quality steels for armaments. The fourth largest steel plant is the Mysore Iron and Steel Works which annually produce about 25,000 tons of light structural shapes and bars. In addition to these four concerns, a number of small mills operate partially or wholly on scrap and produce light shapes and bars chiefly for the bazaar trade. There are 13 electric furnaces in the country; most of these have a capacity of four-fifths ton, but one has a capacity of 10 tons, and two, of 2 tons each.

The Tata Iron and Steel Company, which manufactures a wide variety of steel products, has five well-equipped blast furnaces which, in 1941, produced 1,237,000 tons of pig iron and 29,000 tons of ferromanganese. Of the pig iron produced in that year, 1,015,000 tons were used in the molten state at the foundry and the steel-melting shops. The remaining 222,000 tons were made into pigs which were either sold or consumed at the works. The production of ferromanganese in 1941 exceeded plant requirements which are about 12,000 tons a year. The 40-inch blooming mill has a capacity of 1,000,000 tons a year, provided it is not required to roll alloy steel ingots; the maximum tonnage produced by this mill was 958,599 in 1941. In addition, the company has a continuous sheet bar and billet mill with a maximum production of 577,289 tons, a semicontinuous Morgan mill with a maximum production of 172,344 tons, a plate mill with an annual capacity of 82,000 tons, and sheet mills with an annual capacity of 160,000 tons of black sheets, averaging 24-gage. The sheet mills contain hot mills, finishing mills, an annealing section, and a galvanizing section which has an annual capacity of 125,000 tons of galvanized sheets of 24-gage. On November 29, 1941, the Tata Company began the manufacture of railway wheels, tires, and axles which are produced from its own acid open-hearth steel. The company is also operating a benzol and toluol plant on behalf of the Government of India. It has installed two electric furnaces capable of producing about 1,500 tons of high-quality steel a month, and is operating an ingot mold foundry to increase the output of castings. In addition, the company has extensive repair shops, machine-tool shops, laboratories, and a technical training school. The company is producing a large number of special steels including bullet-proof armor plate, for use in the manufacture of munitions in India.

The Steel Corporation of Bengal also has a modern and efficiently equipped plant which includes steel furnaces with an annual capacity of 250,000 tons of ingots, and a new Sachs blooming mill with an annual capacity of 600,000 to 700,000 tons. Its finishing mills are capable of handling the quantity of steel which could be rolled in the blooming mill. The equipment at the Government Metal and Steel Factory at Ishapore and at the Mysore Iron and Steel Works is being modernized and the capacities of these plants are being expanded.

Expansion of Production.—Various projects for the expansion of equipment essential to the production of steel are now being considered by the Government of India and the steel companies concerned. These extensions, for some of which the equipment has already been ordered, include the following :

<i>Firm.</i>	<i>Type.</i>	<i>Annual capacity Tons.</i>
Tata Iron & Steel	Perrin plant :	
	Acid steel	50,000
	Basic steel	150,000
Steel Corporation of Bengal	90-ton open hearth	75,000
Ishapore (Government)	Three 25-ton furnaces :	
	Special steels	25,000
Mysore	25-ton furnace :	
	Basic steel	20,000
Cawnpore	10-ton open hearth	10,000
	Total	380,000

Source : Department of Supply, Government of India.

Production at the Tata Iron and Steel Company is limited by the capacity of its blooming mill which is taking the company's entire annual output of 1,000,000 tons. This, however, is inadequate to keep the secondary mills operating at capacity. The company is proposing to install a new Perrin-process plant which will increase its annual output of ingots by 200,000 tons ; production will then exceed the blooming capacity by at least 100,000 tons. The company proposes, therefore, to install a billeting mill that will relieve the blooming mill and provide adequate steel to keep the production of secondary mills at a maximum. In addition to these projects for plant expansion, the Tata company is planning, with the aid of the Government of India, to erect three other plants : A plant for the manufacture of special alloy steels, with a capacity of 50 tons a month, a plant with a 15-ton furnace for the manufacture of ferro-alloys, such as ferromolybdenum and ferrotungsten, and additional equipment to enable the mill manufacturing steel plates to operate, on a three-shift basis, at the rate of 10,000 to 12,000 tons a month.

The Steel Corporation of Bengal has a new Sachs blooming mill with an annual capacity of 600,000 to 700,000 tons of ingots. At the time of the Mission's visit this mill was being fed by steel furnaces with an annual maximum production of 250,000 tons of ingots. A project is being considered by the Government of India and the Corporation to increase the capacity of the melting shop in order that an additional 400,000 tons of ingots can be made available to maintain the operation of the blooming mill at capacity. To secure these additional ingots without the erection of blast furnaces, it would be necessary for the Corporation to obtain a substantial amount of pig iron customarily exported to the United Kingdom. The Indian Iron and Steel Company has adequate capacity to feed the new melting furnaces,

provided it is released from its contract to supply the United Kingdom with 32,000 tons of pig iron a month. The Mission understands that this release has been obtained and that negotiations between officials of the Government of India and the Steel Corporation of Bengal are now in progress for the expansion of the melting shop.

Other projects for the expansion of the production of steel in India include the installation of three 25-ton furnaces for the manufacture of special steels in the Government Metal and Steel Factory at Ishapore, and the erection of a 25-ton furnace for the production of basic steel by the Mysore Iron and Steel Works. In addition, there is a 10-ton open-hearth furnace at Cawnpore which, at the time of the Mission's visit, had not been placed in operation.

Projects to increase the production of iron and steel in India must also include a consideration of transportation facilities and of the availability of adequate supplies of water and power. The railroads of India are already greatly overburdened by increased traffic arising out of the war and the temporary closing of the port of Calcutta, and by the loss of rolling stock and locomotives sent to the Middle East. Any substantial increase in the production of iron and steel will place an even greater burden on the railroads which cannot cope with existing traffic. If an increase in the operations of steel mills is contemplated, adequate provisions must be made to move the necessary iron ore and coal to the mills and to move the finished products to their ultimate destinations. With foresight the necessary quantities of water can probably be obtained, but planning is essential because of the seasonal character of the rains. Finally, in any substantial program for the expansion of the industry, provision must be made for the increase of existing facilities for the production of power because the principal steel companies are already taking the capacities of their generating plants.

Government control.—Despite the considerable increase in the production of steel in India, the present supply is inadequate to meet all of the military and essential civilian requirements of the country. Before the war India imported annually about 300,000 tons of steel; since the outbreak of the war, these imports have been greatly reduced, amounting in 1941 to only 100,000 tons. The Government of India believes that India's minimum import requirements for 1942 are 250,000 tons, and that 600,000 tons could be used for war purposes if that amount could be made available.

Since August 1941, the distribution of the whole of India's production of steel has been rigidly controlled by a combined licensing and quota system. The use of tin and of spelter for galvanizing either corrugated or plain sheets is controlled by the Director-General, Munitions Production, as are all ferro-alloys. The steel control has complete authority over the transfer of all available supplies, both imported and domestic. Exports are prohibited except for essential war purposes, and a strict export licensing system is enforced. All applications for import licenses for steel must be approved by the Steel Import Controller. Importers are required to provide full information concerning the specific use for which the material is intended. In this way the Government of India is able to insure that steel is utilized only in the satisfaction of military and essential civilian requirements.

Recommendations.

1. The Mission endorsed the projects for the expansion of plant capacity by the Tata Iron and Steel Company, Ltd. These projects were also approved by the Government of India, and the Mission agreed to use its influence to secure priorities in the United States adequate to provide for the delivery of the necessary equipment and materials.

2. The Mission approved the projected expansion of production by the Steel Corporation of Bengal and urged that it be undertaken promptly. It agreed to use its influence to secure priorities adequate to insure the delivery of equipment and materials which might be ordered in the United States. In view of the acute problem of transportation created by the closing of the port of Calcutta, the Mission expressed the opinion that the pig iron formerly exported, under contract to the United Kingdom could be more usefully employed by expanding the production of steel in the plant of the Steel Corporation of Bengal. The Mission was gratified to learn that, prior to its departure from India, this arrangement had been made with the Government of the United Kingdom.
3. Inasmuch as all of the steel to be obtained from the planned expansion of productive facilities has already been allocated to war or essential civilian uses, the Mission expressed the view that any considerable increase in industrial production would require a further expansion of the productive capacity of the steel companies. The Mission therefore urged that serious consideration be given to the early acquisition of additional equipment and materials for the manufacture of steel.
4. Most of the essential raw materials for the manufacture of tool steel are available in India. A very large part of its requirement, however, must be imported. The Mission recommends, therefore, that a plant for the manufacture of tool steel be erected in India.
5. The attention of the Mission was called to the quality of steel produced by the electric furnaces in India. These furnaces are not now producing the high-quality steels of which they are capable. The Mission recommended that this situation be rectified as promptly as possible and, in accordance with the request of the Government of India, agreed to attempt to secure the services of two qualified experts from the United States to assist in this project.
6. In any program for the expansion of the production of steel in India, the Mission recommends that special attention be given to the problems of providing adequate supplies of water and power and of securing the requisite equipment for transporting the raw materials and the finished products.

MUNITIONS

Before the war India had six ordnance factories devoted to the production of munitions. These were the Metal and Steel Factory at Ishapore, the Gun and Shell Factory at Cossipore, the Rifle Factory at Ishapore, the Gun Carriage Factory at Jubbulpore, the Cordite Factory at Aruvankadu, and the Ammunition Factory at Kukee. When the war began India was engaged in implementing a plan, recommended by a committee under the chairmanship of Lord Chatfield, which provided for the expansion and modernization of these ordnance factories and the establishment of a seventh plant for the production of high explosives. Most of the recommendations of that committee were put into operation by the end of 1941. In the fall of 1940, a Mission from the British Ministry of Supply, under the chairmanship of Sir Alexander Roger, visited India to determine how the industrial production of that country could best be expanded. The Roger Mission recommended a large number of projects for the manufacture of Munitions, chief among which

were the establishment of factories for the production of (1) Bren Guns, (2) shells and mortar bombs, (3) fuses, (4) cartridge cases, (5) ammunition, and (6) scientific instruments. Most of these projects, as well as others recommended by that Mission, have been approved by the Government of India, and work on a number of them has been undertaken.

In addition to the expansion of existing munitions factories and the establishment of new ones, the Government of India has found it necessary to take over four railway workshops which are now being utilized in the production of war materials. One of these workshops was converted into an ordnance factory, a second one is producing munitions and armored vehicles, and the other two are being utilized principally for the production of armored vehicles.¹ A number of other railway workshops are partially engaged in the production of war materials for the Government, and this production is being supplemented by the manufacture of war materials in the workshops of more than 200 private concerns.

Recommendations.

1. The Mission is of the opinion that the present program for the manufacture of rifles is inadequate to meet the Army's requirements for expansion and replacements. It therefore recommends that a new rifle factory, at least equivalent in capacity to the present one at Ishapore, be established at Cawnpore. This location appears to be desirable because a factory building and adequate power are available there.
2. The Mission recommends the establishment of a plant for the production of shells not to exceed 6" in size. It is the opinion of the Mission that a considerable saving in transportation could be effected if the capacity of this plant were adequate to care for anticipated needs in the Middle East and China, as well as in India.
3. The Mission urges the most efficient utilization of existing equipment. It believes that increased production can be obtained by improving the arrangement of machinery in the various plants and by concentrating in specific plants the manufacture of certain types of munitions. At the request of the Government of India, the Mission agreed to attempt to secure the services of a number of production engineers from the United States who would advise the Government of India on these problems.
4. The Mission recommends that every possible effort be made to achieve promptly the objectives established by the Government of India for the production of the various types of munitions.
5. The Mission further recommends that, in those instances in which the production of munitions may be retarded by a shortage of power, a rigorous system of priorities be invoked to curtail its nonessential uses.

ARMORED VEHICLES.

Shortly after the outbreak of war a Tank Development Board was established to design an armored carrier that could be constructed in India. Previously no armored fighting vehicles had been produced there; now it is necessary to import only the chassis on which the armored bodies are mounted. The first vehicles to be designed and put into production was the Mark I Wheeled Carrier based on a standard V-8 Ford chassis fitted with a

¹See section on Armored Vehicles immediately following.

special front axle unit, radiator, and gasoline tank. The body was armored with 6 mm plate produced in India.

Later it was discovered that the Mark I Carrier was restricted in usefulness to general reconnaissance work. It was therefore decided to produce an improved type of carrier. As a result the Mark II Carrier was developed, with a rear engine Ford chassis having a 101-inch wheel base and 4-wheel drive. These chassis are imported from Canada. The armor on the Mark II body ranges from 14 mm in thickness, depending upon the vulnerability of the points to be protected.

The armored Vehicles now being produced in India may be divided into three classes. The *armored carrier* is a wheel vehicle on a Ford chassis with an open-type body, the body weight of the armor being about 2½ tons.¹ *Armored cars* are similar in type except that they have a somewhat heavier body, which is closed, with a revolving turret mounted on the top. The *armored general-purpose vehicle* is also a wheeled vehicle on a Ford chassis, the body being rectangular and covered with about 2½ tons of armor.¹ These last-named machines are used for the movement of troops and supplies, especially on border patrol.

The projected maximum production of armored vehicles in India is 600 a month, to be composed as follows :

Armored cars and carriers	500
Armored general-purpose vehicles	100
Total.	600

It is anticipated that the production of 600 armored vehicles a month will be realized in July or August 1942. Three plants are now engaged in the manufacture of these vehicles and each one is scheduled to produce 200 a month. These plants, which were formerly railway workshops are located at Singhbhum, Tatanager, and Kanchrapara.

Production of armored vehicles in India cannot be increased without the installation of a new assembly plant and the procurement of additional armor plate by importation, or by the expansion of the plate-rolling capacity of the steel mills. The present program requires the delivery of 1,700 tons of armor plate each month, but even that amount cannot be obtained without importing substantial quantities. With existing equipment, India's capacity to produce armor plate is 750 tons a month. This might be increased to 1,000 tons a month, but only by reducing the production of other plate which is urgently required for defence purposes, such as ship repairs and the construction of a 50,000 tons drydock. Because of this situation, the Mission recommended by cable that the United States furnish to India 1,000 tons of armor plate a month. This amount, requested by the Government of India appears necessary to maintain India's present program for the production of armored vehicles.

Recommendations.

1. The Mission recommends that every effort be made to reach and maintain the scheduled production of 600 armored vehicles a month. It believes that this schedule can be maintained more easily after improvements are made in plant organization and assembly methods.
2. In order to permit the execution of the present program; the Mission has recommended to the Government of the United States that it

As reported to the Mission by officials of the Government of India.

provide through the Lend-Lease Administration 1,000 tons of armor plate a month for export to India.

AIRPLANES.

In the latter part of 1940 the Government of India decided to lend its support to the Hindustan Aircraft Company, Ltd., of Bangalore, Mysore State, for the construction of an aircraft factory. The Government of India now owns a two-thirds interest in the company and the remainder is owned by the State of Mysore. For the period of the war the Government has complete administrative and financial control over the factory.¹ This company, which has the only aircraft factory in India, employs 29 American supervisors and 3,400 locally trained Indian mechanics. It has a metal-working and component assembly plant, a foundry machine shop, and an assembly and erection hangar, the total floor space of which aggregates 230,000 square feet. A new hangar for maintenance with floor space of 25,000 square feet is under construction. Its airport has two surface runways, one 3,800 feet and the other 5,000 feet in length. It also has mooring and beaching facilities for seaplanes, and a maximum run of 9,300 feet.

The Hindustan Aircraft Company has been manufacturing wooden and metal air-frame components. With these, and with engines, instruments, and other parts imported from the United States and the United Kingdom, the company has been producing finished planes. At present the company has under contract the manufacture of 30 Harlow trainers, 24 Vultee bombers, 48 Hawk fighters, and 10 training gliders. By April 1, 1942, three trainers, one fighter, and one glider had been delivered. The company has also undertaken the manufacture of 600 52-gallon drop tanks for Hawk and Mohawk fighters. In addition, it is servicing, overhauling, and repairing a substantial number of planes for the armed services of the United Nations.

The mission understands that officials of the company are anxious to continue the assembly of planes at the factory in order that the labor force may be maintained intact. The Mission finds itself in sympathy with this view but wishes to point out that, as air activity in India is increased, there will be a marked demand for facilities to repair aircraft. The Mission is of the opinion that steps should be taken to adjust plant machinery so that the company would be properly equipped for this important task. Provision should be made for the overhaul of engines, the manufacture of certain spare parts (especially those that are bulky, light, and frail), and the maintenance of supplies of other spare parts. The Mission believes that it is impossible to overemphasize the importance of so equipping the company that it may be able quickly to repair the airplanes which have been and are being sent to India by the United Kingdom and the United States.

In March 1942, the repair of airplanes was undertaken on a modest scale by the ordnance factory at Kanchrapara, near Calcutta. The repair work, however, has been severely handicapped by the absence of equipment and of propellers and other spare parts.

Recommendations.

1. The Mission recommends that emphasis be placed on the repair and maintenance of planes in India rather than upon their manufacture.
2. It recommends that every effort be made to obtain the equipment necessary to expedite the repair of planes at both Bangalore and

¹ The technical operations are under the control of Mr. W. D. Pawley, President of the Inter-Continent Corporation of New York. Since 1934 Mr. Pawley has also organized, financed, and managed the Central Aviation Manufacturing Co. in China. He also operates two aircraft factories in the United States.

Kancharapara, and that adequate supplies of spare parts be maintained at these repair centers.

8. Because of the importance of this work the Mission is ready to use its influence to obtain for the Government of India the equipment and materials that will be necessary to carry out these recommendations.

SHIPBUILDING AND SHIP REPAIRS.

Shipbuilding.

The Royal Indian Navy has been increased considerably since the outbreak of the war. James Fighting Ships, in 1940, lists five escort vessels, one patrol vessel, one trawler, and one surveyor; the book states that, in addition, a number of merchant vessels have been taken over for service in the Navy. The Mission understands that the construction program for the Indian Navy includes the following :

37 trawlers, 5 corvettes, 8 wooden mine sweepers, 6 Fairmiles (fast antisubmarine motorboats), 12 light-draught motor launches, 72 feet in length, 2 floating docks, 88 Z craft, 46 skids, 2 mine-sweeping tugs, a seagoing water-boat, and a number of small motor launches.

In 1941 the annual capacity of India's shipyards was 50,000 gross tons.¹ These shipyards, however, cannot build large vessels; special equipment, including boilers and engines, must be imported. They do produce a variety of small crafts; in October 1941 they were fully engaged in the production of about 200 vessels of various sizes. Recently, the construction of a shipyard was undertaken at Vizagapatam which will have a maximum capacity of 8,000 tons when the plant and equipment, on order from the United Kingdom, are delivered. Except for this yard and those at Calcutta and Bombay, the shipyards of India, because of size and equipment, are confined chiefly to the construction of wooden vessels. The port of Cochin, for example, has one yard equipped to construct wooden ships 100 feet in length and a firm at Karachi can produce such ships 72 feet in length. In addition, there are a number of small boat-building firms located in the Cutch, Kathiawar, and Malabar ports.

Of the ships now being produced in India, the corvettes, with a length of 180 feet, and the Bangors, with a length of 171 feet, 6 inches, are the largest. The latter has displacement of 689 tons and a speed of 16 knots. Other classes include the Basset Trawlers which have a length of 150 feet and a speed of 12 knots, Fairmiles, 72-foot motor launches, motor mine sweepers, tugs, lifeboats skids, and tank-landing craft. The principal types and numbers of ships under construction, in India in March 1942, and the locations in which they are being constructed, are shown in table 9.

TABLE 9.
NAVAL CRAFT : TYPE AND NUMBER UNDER CONSTRUCTION IN INDIA.
APRIL 1942.

Type of Vessel.	Calcutta.	Bombay.	Cochin.	Karachi.	Vizaga- patam.	Madras.
Corvettes, 180 ft.	3	—	—	—	—	—
Bangors, 171 ft. 6 in.	4	5	—	—	—	—
Basset Trawlers, 150 ft.	25	6	—	—	2	—
Fairmiles, 110 ft.	18	—	—	—	—	—
72 ft. motor launches	6	3	—	3	—	—
105-ft. motor mine sweepers.	—	—	8	—	14	12

¹ Source : U.S. Maritime Commission.

² Including the completion of two vessels from Rangoon.

³ Vessels from Rangoon that are being completed in India.

Source : Department of Supply, Government of India.

Ship repair.

The importance of India in maintaining in serviceable condition the war and merchant fleets of the United Nations has been greatly increased by the loss of ports in the Malay Peninsula, the Netherlands Indies, and Burma. Moreover, this repair work, which would customarily be distributed among the ports now in possession of the enemy, has been augmented by enemy action, and is now concentrated in the west-coast ports of India because of the operations of the Japanese fleet in the Bay of Bengal. Among the west-coast ports only Bombay has appreciable facilities for the repair of ships. In consequence, temporary repairs, sufficient to enable damaged ships to proceed to ports outside of India, are all that is possible in many instances. Even this task is a severe strain upon the available facilities.¹ The only naval dockyard in India is that of the Royal Indian Navy at Bombay. The facilities at this dockyard are limited, and, should the necessity for repairs and the maintenance of naval vessels of the United Nations be increased, it is likely that such work would encroach on the limited facilities available for merchant ships. The Mission believes it to be of the utmost urgency that existing repair facilities of the west-coast ports should be utilized to the maximum and that such facilities should be expanded as rapidly as possible.

A summary of the repair facilities of the principal ports of India is given below :

1. *Calcutta*.—The port of Calcutta is probably the best equipped in India for the repair of ships, although it is short of berthing accommodations for such work. It has one large tandem drydock and three smaller drydocks. There are three major² and several minor firms engaged in the repairing of vessels.

2. *Vizagapatam*.—This port has a small natural harbor. Facilities for ship repairing are inadequate but a new shipbuilding yard is now under construction there. Assuming the delivery of the requisite plant and materials from the United Kingdom, it could be made suitable for the repair of ships within a few months. The Port Trust is now able to undertake minor repairs and the docking of small craft.

3. *Madras*.—The harbor at Madras is artificial and facilities will permit only above-water and limited major repairs. It has no drydock but does have a small-craft slipway. Repairs are customarily undertaken by either the Port Trust or a private concern,³ and these are sometimes assisted by smaller concerns and a railway workshop.

4. *Karachi*.—Repair facilities in the natural harbor of Karachi could be expanded to relieve congestion at Bombay. This port, however, has one small drydock which is capable of handling only harbor craft. Three major firms are engaged in the business of ship repairing.⁴

5. *Bombay*.—Bombay has a large natural harbor. There is, however, an acute shortage of berthage for ship repair. The port has one large tandem drydock and three smaller docks. It also has a slipway for small vessels. The repairing of vessels is chiefly in the hands of three private concerns and the Royal Indian Navy Dockyard.⁵

* For a previous reference to this subject, see section entitled "Ports."

² These three companies are the Garden Reach, the Shalimar, and the Hooghly Dock Co.

³ The private company is known as Binny & Co.

⁴ These firms are Herman & Mohatta, Ltd., the Karachi Engineering Works and Foundry, and the Dock Engineering and Welding Works.

⁵ These private concerns are Mazagon Dock Co., Alcock and Ashdown, and the Indian Steam Navigation Co.

6. *Cochin*.—The natural harbor of Cochin has limited facilities for repair-ships. There is only one small drydock for harbor craft, and additional berths for repairs are urgently required. Moreover, the port is deficient in facilities for the watering and fueling of ships. The repair work is carried on chiefly by the Port Trust and a private concern, both of which are handicapped by the lack of adequate equipment.¹

Recommendations.

1. The Mission recommends that existing facilities for the repair of ships at west-coast ports should be fully utilized.
2. To achieve this objective, it recommends the continuous operation of these facilities in three 8-hours shifts and the discontinuance of shipbuilding and all other construction that might interfere with the work of repair.
3. The Mission recommends the expansion of facilities for the repair of ships in west-coast ports by the transfer of light, movable equipment from east-coast ports and by the importation of equipment from the United Kingdom and the United States. In this connection the Mission has given its endorsement to a list of equipment required by the port of Bombay and stands ready to endorse similar orders for other west-coast ports, including Karachi and Cochin.
4. Wherever possible, it urges the utilization of additional repair berths and the location of buoys for mooring ships close to repair shops so that work might be diverted from the docks to the stream.
5. The Mission is fully aware of the importance of ship construction to the Royal Indian Navy and to the cause of the United Nations. It recommends, therefore, the continuance at east-coast ports of the program of ship construction, provided that adequate materials can be made available without retarding other more essential projects.

INDUSTRIAL PRODUCTION.

The Mission, in its visits to industrial plants throughout India, had an opportunity to observe operations in privately owned factories and those owned by the Government. Based on its observations, the Mission believes that it will be possible to attain a substantial increase in the production of many articles essential to the prosecution of the war by an improvement in plant and industrial organization. In a number of plants productive efforts were less effective than they might otherwise be because many different articles were being produced simultaneously. This practice, which is apparently quite general in India, prevents the application of mass-production methods and retards production by making it difficult, if not impossible, to segregate into their simplest components the tasks to be performed. Frequently production was further retarded by the inefficient placement of machinery and by the excessive handling of articles arising out of such placement. Provision for adequate light and air and the installation of cement floors in some plants would operate to increase the speed and accuracy of production, and to protect valuable machinery.

The Mission observed that, in some cases identical articles were being produced on a small scale in several different plants. In such instances the advantages of mass production were lost and production was smaller and

¹. The private concern is Brunton & Co.

more costly than it should have been. In other cases, the Mission observed that, because of the lack of essential machinery, it was necessary to move goods to a second plant for partial processing and later to return such goods to the original plant for finishing. Obviously a relocation of machinery would reduce the time of manufacture and the cost of handling. If it were possible to concentrate production in a few rather than in many plants, and if the machinery essential to any single productive process could be located within the plant primarily devoted to such production, the existing industrial equipment in India could be utilized more efficiently and effectively than at present.

Machine Tools.

Another factor affecting India's production of war materials is the acute shortage of machine tools. Before the war India's capacity for the manufacture of such tools was very small, being limited to simple lathes and drilling and shaping machines. A more efficient utilization of existing facilities, particularly in the railway workshops, has enabled India in recent months to increase the volume and types of machine tools produced there. The range of production has been extended to include presses, cold saws, thread millers, tool grinders, slotters, planes, furnaces, blowers, blasting equipment, and rolling mills. Despite this expansion in production, the machine-tool industry in India is not large and is unable to meet minimum requirements. Domestic production, therefore, must be supplemented by imports from the United Kingdom and the United States.

All requests from India for machine tools are routed through the Machine Tool Control in London. This Control attempts to meet India's requests from its own resources or by diverting to India some of the Lend-Lease allotments to the United Kingdom. Requests that cannot be filled in this way are handled by the Indian Purchasing Mission in Washington which places direct requisitions upon the Lend-Lease Administration. The dependence of India upon the United States for machine tools is indicated by the increase in the number of such tools being requisitioned by the Indian Purchasing Mission. Several recent requisitions have received the endorsement of the Mission.

The records of the Machine Tool Control for recent months show that, for the expansion of the war effort, India's current minimum requirements are approximately 9,000 machine tools per annum, of which about 4,000 are required by the Government and 5,000 by other war and essential industries. The Government of India proposes to meet these requirements as follows :—

		1942.	1943.
Tools to be manufactured in India	...	3,860	4,600
Tools to be requisitioned and reconditioned in India.	... ..	2,810	—
Tools to be imported.	...	3,830	4,400
Total.	...	9,000	9,000

These estimates, however, do not include 3,171 machine tools already on order for sanctioned projects for the production of munitions, 453 machine tools for the manufacture of small tools, forged tools, and engineering stores, and 111 machine tools for the expansion of production in existing plants. Moreover, they do not include any allowance for ordinary replacements of machine tools which, based on an expected life of 20 years, would amount to about 4,000 tools a year. Imports of required machine tools into India

should amount to about 3,380 in 1942 and to 4,400 in 1948; in addition, there would be the 3,735 machine tools on order for specific projects and the 4,000 machine tools that are required for ordinary replacements. With the completion of the program of industrial expansion, it may be assumed that India will be able to provide the machine tools necessary for ordinary replacements and that only the more intricate type of tools will have to be imported. But, in order that the program of expansion may be completed, it is essential that India's requirements for machine tools (as indicated above) should be met.

The Government of India established a strict machine-tool control under a Deputy Director-General early in 1941. The Director has power to supervise completely the production and distribution in India of all machine tools. He is empowered to license imports and exports. He can prevent the diversion of essential machines to non-essential purposes and can requisition machines required by factories engaged in the production of munitions. In addition, he has the power to determine the type and quantity of machine tools to be manufactured in the country, and the factories at which such manufacture is to be undertaken. The Government of India is thus able to control completely the manufacture, distribution, and use of machine tools within its own borders.

Small Tools.

Despite the progress made in the production of small tools, India must continue to import substantial quantities of saws, files, precision measuring tools, and cemented carbide cutting tools. The capacity in India to produce high-speed, carbon-steel twist drills, milling cutters, and reamers is inadequate to fill the essential demand. As a result one plant, with an annual capacity of 400,000 drills, has been taken over by the Government, and plans have been completed to quadruple its capacity. Orders for necessary equipment have been placed with the United Kingdom and with local manufacturers. The capacity in India to produce high-speed, carbon-steel taps, dies, and thread-forming tools is also inadequate. A project is therefore being considered for the erection of a factory to manufacture these tools, with an estimated annual output of 300,000. The equipment will be ordered in part from the United Kingdom and in part from local manufacturers. The Government of India indicated that it would look to the United States for the supply of tool steel necessary to maintain the production of these plants; this would amount annually to about 120 tons.

The Agricò works of the Tata Iron and Steel Company produces pickaxes, felling axes, and other hand tools. It has an annual capacity of approximately 2,000,000 such tools and a project sponsored by the Government of India is under way to double that capacity. Orders for three bliss Pick-Eye Presses and one Felling Axe Eye Punching Press have been placed on the Lend-Lease Administration by the Indian Purchasing Mission. Other essential equipment will be obtained in India.

The Government of India has instituted a rigid control over the importation, exportation, and distribution within India of all types of small tools. All tools ordered for India, therefore, whether by the Government or by private concerns, are required for the production of munitions or other essential war materials, and will be devoted exclusively to such purposes.

Other Steel Manufactures.

The production of machinery and machine tools in India is retarded by the absence of equipment for the manufacture of certain essential parts such as roller and ball bearings. A plant for their manufacture would facilitate the production of various types of machinery. Moreover, a plant

or plants completely equipped for die casting would expedite the production of shells and components of munitions as well as of other war materials. A factory for the production of pipes and tubing would effect a saving in both time and shipping space; it would also expedite essential construction and the repair of locomotives. The existence of such a plant would be a particularly important factor in any project for the construction of a pipe line for the transportation and distribution of gasoline in India. There are a number of wire drawing plants in India, but there is no plant for the manufacture of wire screen. This product would have many war uses, particularly in hospitals and barracks, and would doubtless find a large civilian market in the post-war period.

With the proper equipment, the manufacture of scientific instruments could be undertaken in India on a much wider scale than at present. These instruments would have a number of immediate war uses and are essential in any program for the expansion of industrial production. Small electric motors not exceeding 5 horse power would also be useful instruments in such a program. By attaching these motors to individual machines, the current use of shaft and belt drive could be reduced with a corresponding saving in the consumption of electric energy. Small motors could be produced in India which affords most of the essential raw materials, with the possible exception of copper.

Assembly of Motor Vehicles.

The assembly of motor vehicles is a substantial industry in India and is now operating almost exclusively under contracts with the Government. The assembly plants are owned and operated by two United States companies, General Motors and Ford. Their maximum annual-capacity is approximately 96,000 units, of which General Motors can assemble 60,000 and Ford, 36,000. The assembly plant of General Motors is located in Bombay. The Ford Company has three plants; the plant in Bombay has an annual capacity of approximately 21,000 units, the one in Calcutta, 9,000 units and the third in Madras, 6,000 units. All four plants are well-managed and efficiently operated.

The current annual requirements of the Government of India are approximately 84,000 vehicles. Of this number, it is expected that General Motors will assemble 50,000 units and Ford, 34,000. The Mission was informed by Government officials that the capacity for the construction of bodies within India is adequate to meet the requirements of the Government. Inasmuch as the capacity for the assembly of chassis is also adequate, there appears to be no need for expansion in this field.

In order to avoid delays and to permit the most efficient utilization of existing plant capacity, however, the companies concerned should insofar as possible, provide for the regular shipments of parts from Canada to India. Because such shipments are made in CKD pack, efforts should be made to insure the inclusion of all essential parts in each shipment. The possibility of delay in the assembly of many vehicles would be further reduced if each CKD pack were limited to no more than 24 units. Moreover, because vital parts have occasionally been omitted in packing, the companies may wish to consider the advisability of stocking in India those spare parts which experience has shown are most likely to be overlooked.

Cement.

India has 22 plants for the manufacture of cement; these are owned and operated by 7 companies, and have annual capacities of about 2,600,000 tons.¹ One company owns 12 of the 22 plants and accounts for about 60 percent of their total productive capacity. The raw materials for the manufacture of cement are all available in India.

¹ Two of the 22 plants have not yet been completed; combined capacities of the two uncompleted plants will amount to 75,000 tons annually.

Approximately 90 per cent. of the current production of cement in India is contracted for by the Government, as compared with about 50 per cent. in 1941 and 15 per cent. in 1940. Reserve stocks are being depleted, inasmuch as current production is not keeping pace with the demand. Moreover, it appears likely that the requirements of the Government will increase rather than diminish. Indeed, the industry expressed concern over its ability to meet possible future demands of the Government, and has stated its desire to expand plant facilities in order that it might be better prepared to meet future contingencies. The Mission called the attention of the Government of India to these representations and indicated its willingness to assist in obtaining the equipment required by the industry, provided the Government approved the orders submitted to it.

Radios.

Although radios are serviced in India, no sets are assembled or constructed there. The Mission, however, examined the possibility of producing radio sets in India. After conferences with the trade, with officials of the Government of India, and with technicians in the Army, the Mission concluded that special types of radios should continue to be imported. One general-purpose radio set is required in considerable numbers (approximately 5,000 annually) for use in armored cars, airplanes, and in the field operations of the Army. These, the Mission believed, could be manufactured in part, and assembled, in India. It was the consensus that the purely mechanical parts of the set could be produced locally, but that the electrical components should be imported, although the electrical cables required could be obtained in India. Such an arrangement would substantially reduce the weight of materials to be imported and thus conserve shipping space. It would also provide a centrally located supply base and repair depot for Army divisions operating in South Africa, Egypt, Iraq, Iran and China. The Government of India, at the suggestion of the Mission, appointed a full time officer to study the project and to formulate definite recommendations concerning the manufacture of parts and the assembly of this all purpose radio set in India.

Recommendations.

1. The Mission recommends that a serious effort be made to obtain the maximum utilization of existing plant and equipment through the application of mass-production, assembly-line methods. It suggests that the production of one or, at most, of a few articles be concentrated within a single plant and that, when necessary to achieve this objective, machinery be transferred from one plant to another. It suggests, also, that production might be increased by improving the arrangement of machinery within individual plants and by making adequate provision for necessary light and air.
2. At the request of the Government of India the Mission agreed to attempt to obtain the services of several production engineers who might advise that Government concerning the methods most likely to result in the achievement of the objectives outlined above.
3. The Mission approved the plans of the Government of India for the expansion of the production of machine tools. It agreed to attempt to obtain drawings and blueprints of machine tools in the United States that might serve to assist in that production program. It endorsed a number of orders for machine tools placed on the Lend-Lease Administration through the Machine Tool Control in London and the Indian Purchasing Mission in Washington. And it urges that serious consideration be given to the erection of a factory for the exclusive production of machine tools in order to curtail import requirements as currently estimated.

4. The Mission endorsed the program of the Government of India for the expansion of the production of high-speed, carbon-steel tools and also endorsed the orders for materials and equipment placed on the Lend-Lease Administration by that Government.
5. The Mission recommends that serious consideration be given to the establishment of plants for the manufacture in India of the following articles, all of which are important in the war effort as a part of a program for industrial expansion. Roller and ball bearings, pipes and tubing, die castings, wire screen, scientific instruments, and small electric motors. Should the Government of India give favorable consideration to these projects, the Mission is ready to assist in securing the equipment and materials essential to their implementation.
6. The Mission recommends the manufacture of parts and the assembly of an all-purpose radio set in India, and it is ready to assist the Government of India, in securing from the United States the materials and equipment that would be required for this purpose.

NONFERROUS METALS.

The Government of India maintains a complete control over both imports and exports of all nonferrous metals. Exports are permitted to go only to the United Nations and only for essential purposes. The distribution within India of aluminum, copper, lead, nickel, tin, and zinc is under the control of the Government.

Bauxite and Aluminum.

Bauxite.—There are substantial deposits of bauxite in India. Reserves are estimated at about 250,000,000 tons and are located principally in Bihar, the Central Provinces, and Bombay. There are also small deposits in Madras. The better grades of bauxite have an average alumina content of 55 per cent. One of the deposits in the Province of Bombay (Tungar Hill, only 80 miles from the city of Bombay), is estimated to contain 750,000 tons of bauxite with an average alumina content of 49 per cent. Thus far there has been little mining of bauxite in India, and no aluminum has been made in India from Indian bauxite. Exports have been small and sporadic, being largely trial shipments. Because of the great demand for aluminum arising out of the war, plans have been made to develop the Indian deposits. Two companies in India have undertaken projects for the manufacture of aluminum from Indian bauxite.

Aluminum.—The Aluminum Production Company of India, Ltd., is establishing a smelter at Alwaye in Travancore State which, it is anticipated, will be in operation by August or September 1942. This smelter will have an annual capacity of 2,825 long tons of ingots. The plant, however, is so designed that its capacity, exclusive of requirements for power, can be increased to 5,850 long tons by the installation of very little additional equipment, chiefly equipment for melting pots and the rectifier plant.

Sometime ago the Aluminium Production Company entered into a contract with the Government of Travancore State for its electric power. Travancore State, however, was unable to secure the hydroelectric equipment necessary to expand its production and now states that it will be unable to supply sufficient power to operate the smelter at even its initial capacity. Unless additional power can be obtained, the probable output of the smelter will be 1,750 long tons, rather than 2,825 long tons. The office of the Electrical Commissioner has suggested that the power required can be provided by connecting the Travancore State system with the hydroelectric system of the Govern-

ment of Madras. This could be done by erecting a transmission line between the Pallivásal power station and Udmalpet, a switching station of the transmission system of the Madras Government—a distance of above 45 miles. This plan would provide sufficient power to enable the smelter to operate at least at its initial capacity.

The Aluminium Production Company is planning to establish a plant for the production of alumina from Indian bauxite which it expects to obtain from nearby deposits in Madras. This plant, however, may not materialize for some time, although the Government of India is anxious that it be established as soon as possible inasmuch as the company is now depending upon alumina imported from Canada. The company has conducted surveys of many bauxite deposits in Southern India and has obtained options on some of them.

The Aluminium Production Company is a Canadian-British concern into which it is intended to introduce substantial Indian capital and representation after the plant is in operation. At present Aluminium, Ltd. of Canada and the British Aluminium Company each have a 50-per cent interest in the Indian organization, but the control is in the hands of the Canadian company. The Indian concern has a controlling interest in another Indian Company, the Jeewanlal Ltd., which is by far the largest producer of aluminum utensils and other holloware in India.

A second company, the Aluminium Corporation of India, Ltd., was organized in 1938 for the production of aluminum from Indian bauxite. It is the intention of the organizers to establish a complete plant, including the production of alumina, aluminum, and sheet at Anupnagar, near Asansol, in Bengal. It is planned to operate the plant with steam-generated power. Orders were placed for the entire plant with Skoda at most favourable prices. At the outbreak of the war about two-thirds of the necessary equipment had been delivered; undelivered equipment, however, included the three main D. C. generators to supply power for the smelter. Delays in obtaining the essential plant have been experienced, in part because of numerous changes of ownership. Orders were finally placed in March 1941, and shipment from the United Kingdom is scheduled for July 1942. Construction of the plant is proceeding and the production of alumina may be possible by the middle of 1942. It is doubtful, however that ingots will be produced before the end of 1942, even though the generating plant should arrive as now scheduled. The annual capacity of the smelter at Anupnagar is about 3,000 long tons of ingots.

Various attempts have been made to bring about a merger of the two producing companies, but thus far these efforts have been unsuccessful, largely because of disputes between the Canadian-British and Indian interests over the question of control. Inasmuch as one company will soon have a smelter but will be forced to import alumina, and the other will have a plant for the production of alumina but no smelter, it seems obvious that a merger, or at least a working agreement, could be effected that would be mutually advantageous. It would also appear that the Government of India might use its influence to bring about such an agreement in order to save the shipping space that would be required to import alumina from Canada.

Chromite.

There are deposits of chromite, the oxide of chromium and iron, in Bihar, the Eastern States, Bombay, and Mysore, but 95 per cent. of the chromite produced in India comes from north-eastern Baluchistan. From the mines the ore is transported by narrow-gauge railway 46 miles to Khanai, and from there by broad-gauge railway 570 miles to Karachi. There is a large dump at Khanai and there are storage facilities for 20,000 tons of ore at Karachi. The industry in Baluchistan is controlled by the Baluchistan Chrome Company with headquarters in London.

The production of chromite in India and exports of the ore from that country in recent years are shown in table 10.

TABLE 10.
CHROMITE: PRODUCTION IN, AND EXPORTS FROM INDIA, 1937-40.
(In long tons).

Year.	Production.	Exports.
1937	62,807	50,367
1938	44,149	24,452
1939	49,136	37,826
1940	55,511	42,704

Source : Department of Supply, Government of India.

The statistics in table 10 suggests that there is an annual consumption of about 12,000 tons of chromite in India. This material is devoted principally to the preparation of furnace refractories; small amounts are also used in the manufacture of heavy chemicals. There are adequate quantities of ore for the production in India of various chrome alloys, such as ferrochrome and chrome steels.

Copper.

Although it is apparent from old workings that substantial amounts of copper were once mined in India, commercial operations are now conducted in only two places. The more important of these locations is the Singhbhum copper belt in Bihar, where reserves of ore are estimated to be approximately 850,000 short tons yielding 2.88 percent copper; there is also a very small production of copper in Mysore. In recent years the annual output of refined copper has been about 6,600 tons which is approximately the capacity of the only copper smelter in India. This smelter is located at Maubhandar, in the Singhbhum district of Bihar.

Copper ore from the Singhbhum district is nickeliferous, and the refined metal contains as much as one half percent nickel. The quality of Indian copper is adequate for most alloying purposes, but its value as a conductor of electricity is nullified by its nickel content. There is little likelihood in the near future of substantially increasing the production of copper in India. That country, therefore, will be forced to depend on imports of blister copper from Rhodesia for its requirements of ordinary copper, and on the United States or Canada for electrolytic copper. The only alternative would be the installation of an electrolytic smelter for the processing of blister copper from Rhodesia.

Lead and Zinc.

Lead and zinc ores are known to occur in Rajputana and Kashmir, but there is no production of lead and zinc in India. The requirements of that country, therefore, must be met by imports. Since the conquest of Burma, stocks of lead and in zinc India have been rapidly diminishing. In a few months there is likely to be a serious shortage of both these metals, and imports from the United States may have to be provided. Imports of lead and zinc into India in recent years are shown in table 11.

TABLE 11.
LEAD AND ZINC. IMPORTS INTO INDIA, 1938-40.
(In long tons).

Year.		Lead.	Zinc.
1938	...	7,500	22,000
1939	...	9,500	24,000
1940	...	15,000	26,500

Source : Department of Supply, Government of India.

The most promising deposits of lead-zinc ore in India are the old mines Zawar in Udaipur State, Rajputana. The Government of India is planning to develop these deposits which have not been worked for about 100 years because, at that time, mining operations were discontinued when the water level was reached. The extent of the deposits is not known, but samples indicate an ore of excellent quality, averaging 28 percent zinc and 20 percent lead, with 40 ounces of silver to the ton. Moreover, because of the character of the rock, little timbering will be required.

Before operations on these deposits can be resumed, it will be necessary to determine the extent of the ore body and to pump out and otherwise rehabilitate the mines. It is estimated that about 12 months will be required to put the mines in working order. Moreover, equipment for a flotation mill and for lead and zinc smelters will have to be imported and installed. In addition, considerable technical assistance will be required in the installation and operation of the mill and smelters, and in the manufacture of retorts for the zinc smelter. Because of the richness of the ore, however, it would appear desirable to develop these properties, provided the proposed investigation establishes the existence of adequate reserves.

Manganese Ore.

India customarily accounts for about 30 percent of the world's output of manganese ore. Production in India amounted to 1,051,000 tons in 1937 and to 869,000 tons in 1940, most of which was exported. Formerly, exports went to the United Kingdom, Japan, and France; now they are shipped almost entirely to the United Kingdom and the United States. The iron and steel industry in India consumes about 60,000 tons annually. The chief mining areas are the Balaghat, Bhandara, and Nagpur districts of the Central Provinces; others include Sandur (one of the Madras States), Keonjhar and Bonai among the Eastern States, Singhbhum in Bihar, the North Kanara and Panch Mahals districts of Bombay, and Mysore State. Prior to the closing of the Bay of Bengal, manganese was exported chiefly from Vizagapatam which is about 400 miles, via the Bengal Nagpur Railway, from the producing centers in the Central Provinces. Currently, the principal port of export is Bombay. Production and exports of manganese ore, and the production of ferro-manganese, in India, for the years 1937-40, are shown in table 12.

TABLE 12.
PRODUCTION AND EXPORTS OF MANGANESE ORE, AND
PRODUCTION OF FERROMANGANESE, IN INDIA, 1937-40.
(In tons).

Year.		Manganese Ore. Production.	Exports.	Ferro manganese. Production.
1937	...	1,051,594	1,151,884	8,041
1938	...	992,795	648,740	18,385
1939	...	844,663	781,182	1,618
1940	...	868,918	787,735	18,199

Source : Department of Supply, Government of India.

Tin.

There are no known deposits of tin in India that may be operated profitably, even under present conditions. India, therefore, must continue to import tin to meet its requirements which, in the past, amounted to approximately 3,000 tons a year. By the elimination of most civilian uses, and the curtailment of military uses, it is possible that essential requirements may be reduced below past consumption.

Titanium.

Titanium occurs in India in the form of a double oxide of iron and titanium, known as ilmenite. The oxide is used principally in the pigment industry; small amounts are also consumed in the manufacture of steel. In recent years most of the world's supply of ilmenite has come from Travancore State in southern India; there it occurs in the sea sand which also contains monazite and zircon sands. The ilmenite sands in Travancore vary somewhat in metallic content but cover a large area which extends some distance beyond the actual beach and for several miles along the coast. At the water line the sands are renewed each year by wave action. Most of the ilmenite produced in India is exported, and most of the exports are shipped to the United States. The production of ilmenite in India and its exports from that country in recent years are shown in table 13.

TABLE 13.

ILMENITE: PRODUCTION IN AND EXPORTS FROM, INDIA. 1937-40.
(In long tons).

Year.		Production.	Exports.
1937	...	181,047	204,653
1938	...	252,220	225,592
1939	...	237,835	236,476
1940	...	263,152	200,490

Source: Department of Supply, Government of India.

Recommendations.

1. The Mission recommends that a survey of the route for the proposed transmission lines between the Pallivasal power station and Udmalpet be undertaken forthwith, and that every effort be made to effect the early erection of the line, in order that adequate power may be obtained to operate at capacity the smelter of the Aluminium Production Company.

2. It recommends that the capacity of the smelter at Alwaye be expanded to 5,850 tons of ingots as promptly as possible.

3. It further recommends that a plant for the production of alumina from bauxite be erected at Alwaye with a capacity adequate to provide for the expanded smelter.

4. The Mission is ready to assist the Government of India in obtaining the materials necessary for the erection of the proposed transmission line and for the expansion of the capacity of the plant now under construction at Alwaye by the Aluminium Production Company.

5. The Mission recommends that every effort be made to expedite the completion of the plant of the Aluminium Corporation of India, Ltd., in Bengal.

6. It is possible that the two plants for the production of aluminium in India might be operated more efficiently under a single manage-

- ment. The Mission suggests that this possibility might be the subject of an investigation by the Government of India.
7. The Mission recommends that India's requirements for copper continue to be supplied by Rhodesia, Canada, and the United States, inasmuch as there is a shortage of power in India and little saving in shipping would be effected even if the machinery necessary for an electrolytic smelter were made available.
 8. The Mission recommends an immediate survey of the old mines of Zawar in Udaipur State, Rajputana.
 9. Should the reserves prove adequate, the Mission recommends that the mines be rehabilitated and that the necessary equipment for the mining and smelting of lead and zinc be acquired and installed.
 10. The Mission is ready to assist the Government of India in obtaining the equipment and material essential for the execution of this project.

OTHER STRATEGIC PRODUCTS

Mica.

India accounts for about three-fourths of the world's supply of sheet and block mica. Deposits of mica are widely distributed throughout the country, but it is estimated that nearly 80 percent of the total is obtained from Bihar and most of the remainder from the Nellore district of Madras. Deposits of mica are also found in Rajputana, Mysore, Gwalior, and Travancore. Phlogopite is found in Travancore; the other deposits are muscovite. Workers in mica, chiefly women, have a special skill in dressing and splitting the mineral, and this is an important factor in the preeminence of the Indian industry. Indeed, block mica from other countries is often imported into India and then exported in the form of fine splittings no more than one one-thousandth of an inch in thickness. No additional capital or equipment is required to increase production which responds directly to the stimulus of price. Production in 1942 is estimated at 22,000,000 pounds, and officials of the Government of India state that this could be increased to 25,000,000 pounds in 1943 if orders were placed sufficiently far in advance to permit the necessary scheduling of operations. Exports of mica from India go chiefly to the United States and the United Kingdom, and these are shown for recent years in table 14.

TABLE 14.
MICA : EXPORTS FROM INDIA, 1937-40
(In thousands of pounds)

Year				Block and splittings	Scrap
1937	...	...	...	13,554	12,352
1938	...	...	...	8,902	9,376
1939	...	...	...	10,799	7,251
1940	...	...	...	10,990	4,535

Source :—Department of Supply, Government of India

Rubber.

In recent years India has produced annually about 16,000 tons of crude rubber.¹ It is anticipated that by 1943 the annual production of crude rubber will be increased to 18,000 tons and that the output of reclaimed rubber will be established to yield 3,000 tons, thus giving India a total annual production

¹ This does not include the production of crude rubber in Ceylon, the annual output of which is reported to be approximately 100,000 tons.

of 23,000 tons. Machinery for the manufacture of reclaimed rubber, however, must be imported and installed, inasmuch as there is now no such equipment in India. Crude rubber is produced in southern India in the Malabar district of Madras and in north-eastern India in Assam.

The current Indian requirements for rubber are estimated by officials of the Government to be 32,610 tons. If India is to be self-sufficient in rubber products, it must secure 9,610 tons of crude rubber or its equivalent from sources outside the country. It has been estimated that as much as 25 percent of total requirements may consist of reclaimed rubber,¹ the deficiency in India, therefore, could be met by imports of crude rubber from Ceylon and of reclaimed rubber from the United States, as follows :—

	Tons
Crude rubber from Ceylon	6,460
Reclaimed rubber from the United States	3,150
Total	9,610

There are two plants for the manufacture of rubber tires in India ; one is owned and operated by the Dunlop Company of the United Kingdom, and the other, by the Firestone Company of the United States. In 1941 the capacity of the Dunlop plant was expanded appreciably, and orders have been placed for additional equipment for the Firestone plant. It is anticipated that this equipment will be installed and in operation by November 1942. At that time these two plants will have approximately equal capacities for the manufacture of tires and other rubber goods. The present capacity of plants for the production of rubber goods in India, the expanded capacity of these plants with the installation of machinery now on order, and the further expansion proposed by the Government of India are shown in table 15.

TABLE 15.

RUBBER : CURRENT AND PROPOSED PLANT CAPACITIES² IN INDIA
(In long tons)

Product	Present plant	Expanded Plant ³	Proposed expansion
Tires	8,200	14,500	23,500
General rubber goods ⁴	1,200	2,500	3,400
Bicycle tires	1,800	1,500	1,500
Ground sheet and proofed fabrics	2,000	1,250	1,250
Camelback	—	500	1,000
Cable	360	700	700
Respirators	360	560	560
Carriage tires	400	400	400
Footwear	8,657	300	300
Total	17,977	22,210	32,610

¹ 25 percent of total requirements (32,610 tons) is 8,150 tons, from which must be deducted the 5,000 tons of reclaimed rubber that it is anticipated will be produced in India in 1943.

² In terms of customary dry rubber content.

³ Equipment already shipped or on order.

⁴ Hose, sheetings, belting, and miscellaneous rubber goods.

Source : Department of Supply, Government of India.

Imports of rubber and rubber goods, principally tires, have entered India chiefly from Canada and the United States. Small quantities have been supplied by the United Kingdom. The estimated imports into India of various rubber goods for the 12 months ending June 30, 1943, together with the sources of such imports, are listed below in terms of rubber content :

	Long tons
From Canada :	
Tires	7,560
From the United State :	
Tires	2,800
General rubber goods	100
From the United Kingdom :	
Aero tires and original equip- ment on vehicles	300
General rubber goods	300
Total	11,060

According to the estimates it would appear that imports in the current fiscal year will be approximately equal to the deficiency in rubber as calculated by Government officials.

The Government of India exercises a strict control over rubber. It regulates by license both exports and imports; it allocates the supply and controls the purchases and sales of raw rubber. Stocks in the hands of estates, dealers, and factories are required to be reported monthly. All sales or transfers of rubber to manufacturers are prohibited except by permit, and consequently the manufacture of rubber for anything but authorized requirements is prevented. Since June 15, 1942, automobile tires have been strictly rationed. The purchase of new tires or tubes has been restricted to operators of vehicles which are essential for the maintenance of war production or for the health or safety of the community. Permits are required for the retreading of tires.

Shellac

India is the world's largest producer of lac, a resinous substance secreted by a scale insect living on the twigs of trees. Production in India is centered in the northern part of the country, and ranges from 40,000 to 50,000 tons of raw lac a year, most of which is exported. Cultivation is distributed extensively in small holdings. By far the principal market is the United States where it is used chiefly in the production of varnishes and lacquers. Should India develop a substantial industry for the manufacture of paint, it is possible that increased quantities of lac would be used locally. An increase in the quantity of lac gathered or in its production; however, does not appear necessary. The Chief problem is that of securing adequate transportation to the United States.

Recommendations.

1. While in India, the Mission recommended that the United States and the United Kingdom purchase jointly their requirements of mica. It is gratified to note that this recommendation was favourably received and that a Joint Purchasing Mission has been established.
2. The Mission recommends that the orders of the United States and the United Kingdom for mica be placed as far in advance as

possible, in order that the industry may adequately schedule its production program and provide for the continuous employment of the workers.

3. The Mission believes that considerable saving in shipping could be effected by providing for the self-sufficiency of India in the production of most rubber products, particularly tires. Such a development would also reduce the hazard of shipping crude material to the United States or Canada and of reshipping the finished product to India. Moreover, the armed forces in India could probably be supplied more effectively by a local industry than by imports because of the frequent delay in the movement of ships.
4. For these reasons, the Mission recommends that the Combined Raw Materials Board allocate to India the amount of crude and reclaimed rubber necessary to make that country self-sufficient in the production of rubber products.
5. If the Board acts favorably upon this recommendation, the Mission recommends that the necessary equipment and material be acquired for the expansion of plant capacities.
6. The Mission also recommends that the necessary equipment and materials be acquired for a plant to produce annually 5,000 tons of reclaimed rubber.
7. The Mission further recommends the acquisition of machinery and materials necessary for the retreading or recapping of tires, inasmuch as a considerable saving in rubber would be effected thereby.
8. The Mission is ready to assist the Government of India in securing the equipment and materials necessary to implement these recommendations.

CHEMICALS AND DRUGS

Chemicals.

Most of India's requirements for fine and heavy chemicals are met by imports, although in 1938 there were 30 chemical factories in India with about 4,500 employees.¹ That country's dependence on imports for chemicals is indicated by the value of the different types received from abroad in 1939, as shown below :

Types	Value in rupees
Dyes and tanning materials	34,725,889
Industrial chemicals	34,308,188
Drugs and medicines	22,865,081
Fertilizers	12,048,971
Paints and painter's materials	8,805,556
Miscellaneous ²	2,353,930.
Total³	115,107,615

The chemical industry in India, however, is expanding. Notable increases have occurred recently in the production of sulphuric and nitric acids and of aluminium sulphate; there has also been some increase in the production of hydrochloric acid, sodium sulphate, and magnesium sulphate.

In general, the importation of chemicals into India is due to the absence of necessary equipment and technical personnel. For most basic chemicals the essential raw materials are available in India. Various projects for the pro-

¹ 15 of the 30 factories are located in Bengal.

² Includes printer's ink, gelatin glue, perfumed spirit and denatured spirit.

³ Source: Compiled from official statistics of Government of India.

duction of chemicals are set forth in the following memorandum submitted to the Mission by the Government of India:

"This statement shows India's position in regard to 24 chemicals which are important to the war effort, and for the increased production of which, in India, American assistance might be possible. In the basic alkali group the most important shortage is that of caustic soda. If India is to be made self-sufficient, manufacture to the extent of 20,000 tons per annum will have to be established. If this step were taken, and the electrolytic process used, chlorine and bleaching powder which are also at present in very short supply, could be made in sufficient quantities to meet all Indian requirements. At present indigenous production of caustic soda amounts to about 6,000 tons. New plant is under erection which is expected to produce a further 8,700 tons by the summer of 1942. A further capacity of 20,000 tons is needed. The establishment of such a plant would also enable bleaching powder and chlorine deficiencies to be met.

"There is a shortage of what are generally known as coal-tar chemicals with the exception of benzene. Production could be increased if the iron and steel industry were expanded and new coke ovens set up. Benzene is at present being used mainly as a petrol substitute. It could be utilized as one of the primary chemicals for a dyestuffs industry but considerable plant and technical knowledge would have to be obtained to produce the vast range of products necessary. Furthermore, other basic dyestuffs chemicals such as toluene and naphthalene are at present in short supply on account of heavy defence demands. Phenol is also required for the manufacture of plastics, as are formaldehyde and urea. Formaldehyde manufacture is being established on a small scale in Mysore and the production of urea is very little beyond the experimental stage. Both these chemicals as well as phenol would have to be imported in order to establish a plastics industry to manufacture bakelite and beetleware.

"*Chemicals required by the ordnance factories for ammunition production.*— These are acetone nitric and sulphuric acids, ethyl alcohol, ammonia and ammonium sulphate, lime, toluene, dimethylaniline and glycerine. Indigenous production of sulphuric acid, while ample to meet ordnance factory requirements, is not sufficient to meet all the needs of Indian industry. For this purpose an additional plant to expand production by about 10,000 tons will be required. The position is satisfactory in the case of other chemicals required for ammunition production, except toluene and dimethylaniline, and possibly ammonia. The toluene deficiency is about 1,300 tons. Increased production, as stated above, under coal-tar chemicals depends upon expansion of the iron and steel industry and the setting up of new coke ovens. Dimethylaniline requires methyl alcohol as one of the primary materials, and production of this alcohol is at present limited to recovery from the wood distillation plants of the Mysore Iron and Steel Co. There is a project under consideration in connection with the production of antigas ointment for the setting up of acetic acid production by wood distillation, and methyl alcohol would be obtained as a by-product. Advice and plant may be required for production of acetic acid from alcohol or molasses.

"Other ammunition requirements are the carbonates, nitrates and peroxides of barium and strontium and potassium chlorate and perchlorate for pyrotechnics; reduced hammerscale and alumin-

ium powder for incendiary bombs; also sodium azide and mercury for detonators. Most of these chemicals are required in comparatively small quantities and production is being established wherever possible. In other cases imports should not present difficulty as the total quantities involved will only amount to a few tons.

“Large volcanic deposits of sulphur rock have been found in Baluchistan and the Government of India has arranged to excavate and sell crude sulphur for direct use in ‘Chamber’ sulphuric acid plants. It was originally intended to refine the sulphur rock, but difficulties have been experienced and it has not been possible to place refined sulphur on the market. Technical advice and assistance might enable a useful contribution to be made towards strengthening India’s supply position in essential chemicals by the evolution of a practicable refining process”.

Plans are now going forward for the acquisition of a plant for the production of refined sulphur from the sulphur rock of Baluchistan which contains about 50 percent of siliceous impurities. A project is also under consideration for the establishment in India of a plant for the manufacture of coal-tar derivatives which are the essential bases in the manufacture of explosives and chemical products. The by products of such a plant would include coke, gas, ammonium sulphate, light oils, and tar. The light oils are used in the production of T.N.T. and the ammonium sulphate in the manufacture of fertilizer. Tar has many uses; it is especially important in the construction of roads. Coke and gas are valuable by products that could be used by iron and steel mills.

The Government of India already has on order equipment for a plant to produce ammonia. And it is considering the possibility of securing the necessary equipment for plants to manufacture sodium sulphide and antivenom, a chemical to counteract the effect of poison gas. Although there are several factories for the production of paint in India, imports are substantial. Moreover, the requirements for paint in India are likely to increase because of the enlarged war demand. A considerable saving in shipping could be effected if India were to become self-sufficient in the manufacture of this product. Nearly all of the necessary raw materials for the production of paint are available in India.

सत्यमेव जयते

Drugs.

India is responsible for the supply of medical stores of all kinds to the armed forces in the Far Eastern command, and for the supply of those medical stores that it produces, to the armed forces in the Middle Eastern command. Considerable difficulty has been experienced in obtaining medical supplies from the United Kingdom, and consequently the production of drugs in India has been expanded. Whereas before the war only 25 percent of the medical stores for the Army were manufactured in India, 60 percent of the army’s requirements are now produced there. There are many items, however, that are not manufactured in India, and the quantity of drugs produced there is not always adequate to meet both the military and civilian demands.

The production of drugs in India is chiefly in Government depots. There is a private industry but it is of recent origin and small in capacity. The policy of the Government has been to continue the manufacture of drugs in its own depots until private industry is able to supply the demand. In pursuance of this policy, the Government is considering the installation of an additional plant for the manufacture of drugs in India, in order that that country might become practically self-sufficient in these important products. The installation and the operation of such a plant would doubtless require the services of experts and technicians who would have to be obtained from either the United Kingdom or the United

States. Such a plant, however, would eliminate the possibility of the loss of drugs at sea and would provide a central location for the supply of these essential articles in the Eastern and Middle Eastern areas. Most of the raw materials for the manufacture of drugs can be obtained in India.

In addition to the plant for the production of drugs, the Government of India wishes to obtain the equipment and materials necessary for the establishment of plants to manufacture coal-tar intermediates (for the production of synthetic drugs) surgical instruments, record syringes, and surgical gloves. The annual requirements of the Army in India are 600,000 syringes and 630,000 pairs of surgical gloves.

Recommendations.

1. The Mission recommends the acquisition of a plant for the refining of sulphur now being mined in Baluchistan.
2. It recommends the establishment of a plant for the manufacture of coal-tar derivatives.
3. It endorsed the projects of the Government of India to establish plants for the manufacture of sodium sulphide and antiverm.
4. It agreed to use its influence to obtain early deliveries on equipment already ordered for a plant to produce ammonia.
- 5.² It suggests that consideration be given to the establishment of an additional factory for the production of paint, in order that India may become self-sufficient in this product and thereby effect a saving in shipping.
6. It recommends the establishment in India of an additional plant for the manufacture of drugs in order that India may be nearly self-sufficient in these important products.
7. The Mission recommends the acquisition of the necessary equipment and materials for the production of coal-tar intermediates, surgical instruments, record syringes, and surgical gloves.
8. The Mission agrees to assist the Government of India in obtaining the machinery and materials necessary for the erection of these various chemical and drug plants.

TEXTILES

Jute and jute manufactures.

India is the sole source of the world's supply of jute, and that product, next to cotton, is India's largest agricultural export. Production is centered in Bengal which accounts for about 90 percent of the total; other producing areas are the provinces of Assam, Bihar, and Orissa. In recent years production has ranged from 5,500,000 bales (1931) to 13,000,000 (1940); the average annual production has been about 9,000,000 bales.¹ Sowing begins each year toward the end of February and is completed by the end of May; the crop is harvested in the months of July through September. Approximately one-half of the total crop is exported as raw jute, and the remainder is manufactured into hassian or gunny cloth and bags in Indian mills. Most jute manufactures are also exported, inasmuch as India's requirements are not large. Before the war continental Europe was the principal market for Indian exports of raw jute and the United States was the principal market for jute manufactures, especially the cloth known in this country as burlap.

¹ Each bale weighs 400 pounds.

In the decade 1930-39 the jute mills of India suffered severely from over production. As a result the Government of Bengal, in 1938, promulgated an ordinance restricting output. Under the Bengal Jute Regulation Act the Government of Bengal has the authority to control the amount of jute sown in each season.

With the outbreak of the war an unusual demand was placed upon the jute mills, and the plantings of jute were increased. The crop in 1940 amounted to 18,100,000 bales which, together with the 2,800,000 bales left over from the previous season, created unusually large stocks for manufacture or export. The fall of France and the closing of continental European markets curtailed the exports of raw jute so that 7,900,000 bales remained in stock when the harvesting of the 1941 crop began. This crop was the first to be regulated in Bengal and the acreage sown was two-thirds of that in 1940. The yield in 1941 was about 5,400,000 bales, making a supply of 18,800,000. The probable demand for the fiscal year 1941-42 is estimated at about 8,500,000 bales, and the carry over before the 1942 crop, at 4,800,000. Sowings in the 1942 season will be so regulated as to satisfy all probable demands in the fiscal year 1942-48, but no margin above estimated requirements has been allowed because of the necessity for stimulating the production of rice, the supply of which has been curtailed by the fall of Burma.

Before the war, when jute mills in India were working 45 hours a week, they consumed annually about 6,750,000 bales.¹ Shortly after the war began, the Government allowed an extension of working time beyond the normal maximum of 54 hours a week permitted by the Factory Act to 60 hours a week a single shift. On this basis the mills would consume about 7,200,000 bales annually.¹ The raw material position, therefore is satisfactory.

India has 110 jute mills, most of which are in or near Calcutta in the Province of Bengal. These mills have more than 1,800,000 spindles and 68,676 looms, and employ more than 250,000 persons. Operating on the basis of 60 hours a week, their annual production of cloth and bags exceeds 1,800,000 tons. India's war and essential civilian requirements for jute goods are estimated at about 46,000 tons; the remainder is available for export. The primary problem affecting jute and jute products, therefore, is not production but transportation which has been adversely affected by the closing of the Bay of Bengal to ships of the United Nations. Jute and jute products, exported from India, must first be transported across the country by rail to Bombay or one of the other west-coast ports, and shipments are being retarded because of this and other unusual burdens placed on the railroads.

Cotton and cotton manufactures.

India is the world's second largest producer of cotton, being exceeded by the United States. Annual production averages about 7,000,000 bales of 400 pounds each. The cultivation of cotton is widely distributed throughout India, but there are two principal producing regions. The south-central section of the country embracing Bombay, the Central Provinces, the State of Hyderabad, and Madras; and the northern section including the Punjab and the United Provinces. The average annual yield of cotton per acre is appreciably lower in India than in the United States, and very much lower than in Egypt. Customarily, about one-half of the cotton produced in India is used by local cotton textile mills

¹ As reported by officials of the Department of Supply, Government of India.

and the remainder is exported. Before the war the principal market was Japan. The closing of this market has created a surplus of raw cotton in India which is only partially offset by the enlarged demand of Indian Mills. These mills have increased their production to meet war demands and to compensate for the cessation of imports of cotton manufactures from Japan. Although India has a surplus of cotton available for export, it is short-staple cotton. India, therefore, must import annually about 42,000 bales each of East African and Egyptian raw cotton for the spinning of fine thread counts to be used in the manufacture of certain war supplies.

The manufacture of cotton textiles is undoubtedly the largest industry in India. There are about 390 mills in the country, with 10,000,000 spindles and 2,000,000 looms. The workers employed number about 450,000. The annual output of these mills is between 5 billion and 6 billion yards. The cotton spinning and weaving industry is centered in the Presidency of Bombay which accounts for approximately two-thirds of the total production. The two principal centers of production in the Province are the cities of Bombay and Ahmedabad. India's total production of 8 billion yards, which includes the annual output of the hand-loom industry of 2 billion yards, is sufficient to meet that country's military and civilian requirements. Indeed, the cotton textile industry has pledged 20 percent of its production to meet military requirements and would, if necessary increase this percentage.

Inasmuch as the capacity of the cotton textile mills is adequate to care for India's requirements, no major projects for new plants are necessary. A limited amount of additional equipment, however, is required to obtain the maximum potential capacity of existing mills. Most of this machinery will be obtained from the United Kingdom which supplied the initial installations. In order to obtain additional power and to have adequate facilities for emergencies, however, the Government of India has requested that the United States supply a few electric motors for use in the cotton textile industry.

Wool and wool manufactures.

The total wool clip of India is estimated at about 200,000 bales of 880 pounds each, or 66,000,000 pounds. Production is widely distributed throughout India, but the principal centers are the Punjab, the United Provinces, Sind, and Baluchistan. Before the war exports from India ranged from 40,000,000 to 50,000,000 pounds. The United Kingdom and the United States were the principal markets. In 1941-42 India imported 13,400,000 pounds of Australian and South African Wool and 10,600,000 pounds of Australian tops.

The production of wool in India is more than adequate for that country's manufacturing capacity for blankets, both machine and hand-woven. Most Indian wool, however, is not suitable for combing, although a few frontier types and the Tibetan wools, with a combined clip of about 5,000,000 pounds annually, can be combed for use in the coarse varieties of worsted and hosiery yarns. The quality of the finished article, however, is inferior, and the combing yield is 40 percent less than for Australian and South African wools. The combing of local wool, therefore, would greatly reduce the efficient use of combing equipment which, even when employed to capacity on imported wools, is only sufficient to meet about 40 percent of India's war requirements. The remainder must be imported chiefly from the United Kingdom or Australasia in the form of tops, finished woolen materials, knitted garments, or knitting yarn which is utilized by the cottage industries as well as the mills.

There are about 30 woolen and worsted mills in India. The woolen industry is small, with limited output. The industry has about 45,400 spindles with an adequate complement of looms, and is engaged in the production of heavy woolens, such as blankets, heavy coating materials, and serges to meet the military demand. The blankets are made entirely from Indian wool, and mill production, amounting to 2,500,000 annually, is supplemented by hand-woven and hand-spun blankets which are being produced at the annual rate of about 2,000,000. Annual requirements for use in India and for exports, however, amount to 5,000,000 blankets; thus there is an annual deficiency of about 500,000. The heavy coating materials and serges are customarily made from imported wool. The coating materials can be made from Indian wools, but the quality does not compare favorably with those made from imported wool. The worsted industry in India has about 88,700 spindles and an adequate number of looms, but these are quite insufficient to meet the demand for worsted materials and hosiery.

The entire output of the wool manufacturing industry has been taken over by the Government of India for the duration of the war. To increase India's manufacturing capacity for woolens and worsteds to meet war demands the Government has estimated that the following additional equipment would be required:

Spindles for woolens	... 70,000 with all necessary complementary equipment
Spindles for worsteds	.. 50,000 with combing and other complementary equipment.
Looms	... 3,000.

To provide the necessary raw material for this additional plant, it is further estimated that 45,000,000 pounds of raw wool would be required annually. Most of this wool would have to be imported, but wool for the manufacture of blankets could be obtained locally, inasmuch as all, or nearly all, of the machinery required for this industrial expansion would come from the United Kingdom, the Government of India made no request for assistance from the American Technical Mission.

Silk and silk manufactures.

Raw silk is produced in southern India in Mysore State and Madras, and in northern India in the Provinces of Bengal, Bihar, Assam, and Kashmir. Annual production amounts to about 1,600,000 pounds, but of this quantity only about 850,000 pounds is filature-reeled, the remainder being hand-reeled not of standard quality. Only silk that is filature-reeled is suitable for the manufacture of parachutes. The total production of this type of silk is being purchased exclusively by the Government. India is not a large exporter of silk. Indeed, the country is a net importer of that commodity which is used in the production of special types of hand-woven textiles characteristic of India.

The annual value of the silk goods produced in India has been estimated to range from \$20,000,000 to \$25,000,000. There are three small mills, in Calcutta, Bombay, and Mysore, in which silk fabrics are manufactured on power-driven looms, but the quantity of raw silk utilized in these mills is a very small part of the total, the hand-loom weaver being by far the largest consumer. Important weaving centers are Benares, in the United Provinces, and Surat, in the Presidency of Bombay. Other centers are in the Punjab, Bengal, the Central Provinces, Bihar, Mysore, Madras, and Kashmir. Exports of silk goods are not large, most of the

production being consumed locally. The handloom industry is protected by a duty imposed on both silk and rayon, effective May 1934.

Recommendations.

1. The Mission recommends that every effort be made to expedite the movement of jute products by rail, although it recognizes the unusual conditions under which the railroads of India are now operating.
2. Inasmuch as the capacity for the manufacture of jute products in India exceeds the effective export demand, the Mission recommends the conservation of electric power by the closing of those Jute mills, the products of which are not now required.
3. The Mission recommends that the request of the Government of India for electric motors to provide additional power and emergency equipment for the cotton textile industry be supplied through the Lend-Lease Administration.
4. The Mission recommends that efforts be made to expand the capacity for the production of filature-reeled silk in order that more substantial quantities of this important material may be made available for the manufacture of parachutes for India and others of the United Nations.

Hides, Skins, and Leather.

It is estimated that there are about 200,000,000 cattle, 26,000,000 goats, and 22,000,000 sheep in India. Because of the religious tenets of a large number of the Indian people, only a small percentage of Indian raw hides are from animals actually killed or slaughtered; most of the hides are from animals that have died from natural causes. The annual production of marketable raw hides is estimated at about 7,000,000. In relation to the number of cattle, this production is considerably below that in most other cattle-raising countries. Moreover, the average quality of the hides from India is lower than that of hides from the United States and Argentina.

India is the world's third largest producer of sheepskins, being exceeded only by the United States and Australia; average production in India is somewhat in excess of 15,000,000 skins. India, however, is the largest producer of goat and kid skins in the world; annual production amounts to about 84,500,000 skins, or approximately 30 percent of the world total.

India is a large exporter of hides and skins. Exports of these products from India in recent years are shown in table 16.

TABLE 16.
HIDES AND SKINS : EXPORTS FROM INDIA.

Type.		Fiscal year 1935-36.	Average 1934-38.		April 1, 1941 to March 31, 1942.	
			Tons.	1,000 pcs.	Tons.	1,000 pcs.
Hides ¹		...		4,556	...	2,126
Raw	...	22,677		...	8,915	...
Tanned	...	14,029		...	26,994	...
Skins ²		...		50,012	...	36,682
Raw	...	21,195		...	25,878	...
Tanned	...	6,275		...	3,682	...

¹ Principally cattle hides.

² Principally goat and sheep skins.

Source : Official statistics of the Government of India.

The recent decline in the exports of hides and skins from India is due to the closing of markets in continental Europe and Japan to the products of India, and to the increased demand for hides and skins within India. The decline in the exports of hides occurred entirely in raw hides, tanned hides having increased somewhat over previous years. The decline in exports of skins, however, is due chiefly to the reduction in exports of tanned skins. Most of the hides are customarily exported from Calcutta, and most of the skins, from Calcutta, Bombay, Karachi, and Madras. Since the closing of the Bay of Bengal, however, this traffic has been diverted to ports on the west coast.

In 1938 there were 14 leather and shoe factories, 32 tanneries, and 9 hide and skin processing plants in India. These plants are located principally in Cawnpore, Bombay, and Madras. Since the outbreak of war the production of leather and leather goods has been expanded appreciably because of the increased demand for consumption within India and for export to the United Kingdom. Exports of boots and shoes, for example, were 4,000,000 pairs in the 12 months beginning April 1, 1941, as compared with 3,000,000 pairs in 1939. The United Kingdom is the principal overseas market for tanned hides and skins from India; it is also the principal market for leather goods, especially boots and shoes. India's military and essential civilian requirements for boots and shoes, and the orders placed in India for these products by the United Kingdom, exceed India's productive capacity. This matter was called to the attention of the Mission by the Government of India which requested assistance in obtaining additional machinery and equipment for the manufacture of boots and shoes.

Recommendations.

1. The Mission recommends that the additional equipment necessary for the Government of India to meet its requirements for boots and shoes be made available through the Lend-Lease Administration.
2. The Mission suggests that any substantial increase in the productive capacity for shoes and other leather goods may place a severe burden on the tanneries of India. The Government of India, therefore, may wish to consider the possibility of expanding the capacity of tanneries as well as leather factories. The Mission is willing to assist the Government in obtaining the machinery and equipment necessary for such expansion.

TIMBER AND LUMBER

Forests cover about one-fifth of the land area of India. British India has nearly 95,000 square miles of timberland, or more than 11 percent of the country's total area; in addition, there are extensive tracts of timber in the Indian States. It is estimated that the annual yield of timber and fuel from India's forests amounts to about 376,000,000 cubic feet. The forest areas are well-distributed throughout the country; in the north are the great coniferous forests of the Himalayas, in the south the teak and furniture woods of the Western Ghats, and in the central region the varied timbers of the jungle areas. There are about 28 different Indian woods already in commerce, and in some instances, as many as 12 different grades of one kind of timber are recognised.

Large quantities of timber are required by the armed forces within India and in other Empire countries. In response to this demand India has exported substantial quantities of timber and lumber to Empire countries and to others of the United Nations. Because of the enlarged demand, it is anticipated that the production of sawed timber in India may amount to as much as 750,000

tons in 1942. In addition, the lumber industry is currently engaged in the production of 10,000,000 tent poles and 76,000,000 tent pegs. Large quantities of lumber are required for the construction of barracks, munition boxes, and other products for the armed forces. Moreover, timber is of course in demand for such indirect war uses as the construction of telegraph poles, railway ties, wharf timbers, and bridges.

In addition to lumber, India's forests provide a variety of raw materials for the manufacture of paper, and substantial amounts of such materials are annually exported. There are several pulp and paper mills in India, located in Bombay, Bengal, the United Provinces, Madras, Punjab, and Travancore. These mills produce wood pulp and, prior to the war, they also manufactured annually 33,000 tons of bamboo pulp and 22,000 tons of sabai grass pulp. India's paper mills produce kraft, writing, and printing paper, and supply about one-fifth of local requirements.

The forests of India are under the direct control of the Government. Private lumbering operations are conducted under license and have been a source of considerable governmental revenue. The forest resources of the country, however, do not appear to have been adequately developed and only a small part of the total is actually being exploited. The Department of Supply, operating through the Provincial Governments, now exercises considerable control over the distribution of timber in India. The Timber Directorate of the Department arranges for all purchases of timber, lumber, and woodwork required by the defence services. The agencies for obtaining timber are the Forest Departments of the Provinces and States which, in this connection, operate as executive branches of the Timber Directorate. The Directorate maintains timber depots at Karachi, Bombay, Cochin, and Calcutta, having a capacity of about 60,000 tons of timber. These depots are designed to meet the demands of Overseas Commands.

The estimated direct and indirect requirements of sawed timber for the armed forces in 1942 are 750,000 tons. Of this quantity, only about 450,000 tons can be sawed by hand in the forests; the remainder must be sawed at the mills. Although there has been a considerable increase in mill capacity, the current annual output is estimated at only 150,000 tons. In order to meet defence requirements, therefore, the Government of India requested that additional equipment for saw-mills be made available. It suggested that the most efficient type of machinery for work in India would be small, portable mills, driven by steam, and that the aggregate annual capacity of these mills should be 100,000,000 board feet, or 166,666 tons. All sawmill equipment, including band and circular saws, must be imported into India, with the exception of small band saws suitable only for cutting softwoods.

The Mission observed that sawed lumber from the forests was transported to manufacturing centers without being dried or seasoned. This practice greatly increases the weight of the lumber transported by the railroads. It adds, of course, to the cost of transportation and represents an inefficient utilisation of transportation facilities. If drying kilns were erected adjacent to the sawmills or to lumber mills at the railheads, it would be possible to season the lumber prior to shipment, thereby effecting an increase in transportation efficiency and a reduction in its cost.

In addition to indigenous woods, India requires annually between 15,000 and 20,000 tons of Oregon pine for shipbuilding and ship repairs, there being no adequate substitute available there. Supplies of Indian fir and spruce are located in the north western Himalayas, and are too far from the shipbuilding and ship-repair yards to permit their economical transportation. Moreover, the timber must be floated down narrow streams to reach the

railways and therefore can only be supplied in short lengths. The Indian Government requested that adequate amounts of oregon pine be supplied by either the United States or Canada.

Although the plywood industry in India has recently been expanded, its annual production is now about 5,000,000 square feet and is just adequate to meet military requirements and those for the manufacture of tea chests. India has additional and increasing need for plywood for the assembly and repair of aircraft and for the manufacture of light pontoons and assault boats. For the manufacture of such plywood, the Government of India requires modern machinery, including hot presses; it would also require equipment for the manufacture of synthetic resin which is now produced only in very small amounts.

India consumes annually about 3,500,000 square feet of wallboard, such as Celotex or Masonite, most of which is imported. It would be possible to expand appreciably the consumption of this product for both military and essential civilian requirements, and thus eliminate some of the non-essential uses of lumber. India has adequate supplies of raw materials for the production of wallboard but lacks the necessary machinery and equipment.

Recommendations.

1. The mission recommends that the Government of India review carefully its administration of forest resources in an attempt to improve their development and exploitation, not only because of the advantages to be derived from such a policy in the present emergency, but also because of the benefits that would be certain to accrue in the future.
2. It recommends that India be supplied with portable steam-driven sawmills, having a combined annual capacity of at least 100,000,000 board feet.
3. It suggests that careful study be given to the problem of transporting lumber made of Indian fir and spruce from the Himalayas to the principal consuming centers. Should this prove impractical, the Mission recommends that adequate quantities of Oregon pine be made available to India for use in the repair of ships and in essential ship construction.
4. It also recommends that additional machinery and equipment for the manufacture of plywood be made available to India in order that the Government may meet the increased demand that military necessity has placed upon it.
5. It further recommends that the machinery and equipment necessary for the manufacture of wallboard be made available to the Government of India in order that local production may replace imports.

FOODSTUFFS

Inasmuch as most foodstuffs are products of agriculture, they do not come directly within the purview of the Mission. It wishes, however, to make a few comments on related subjects which it believes might effect, at least indirectly, India's industrial war effort. India has long been a very large producer of rice, the annual quantity harvested being about 25,000,000 tons. Although production in India accounts for about two-fifths of the world total, this rice has all been consumed within the country and large quantities, ranging from 1,500,000 to 2,500,000 tons, have regularly been imported from Burma, Thailand and French Indochina. These regions are not now possible suppliers and, therefore, production in India must be increased to

meet basic requirements. Because of the urgency of this situation, the Mission was gratified to note the energetic steps being taken by the Government of India to stimulate the cultivation of this essential cereal. Tea is also a major agricultural crop in India, but it presents no special problem, except that of transportation from the principle producing centers in Assam, Bengal, Travancore, and Madras to the United Kingdom and the United States.

The Mission feels impelled to call attention to the lack of modern slaughterhouses and refrigeration plants in India. Such equipment, it believes, is essential to the proper rationing of the armed forces of the United Kingdom and the United States. Despite possible political difficulties, it suggests that the Government of India, as a war measure, may wish to consider the advisability of erecting such plants. Similarly, the Mission observed what appeared to be a need for the purification of two basic constituents in diet, salt and water. Inasmuch as salt is a Government monopoly, the installation of a salt purification plant should present no great difficulty. And the chlorine produced in India could be used to assist in the purification of the water supply at locations judged to be strategic by the armed forces.

Two specific problems relating to foodstuffs were placed before the Mission by the Government of India. One of these was the preserving of fruits, vegetables, and jams, the raw materials for which are all produced locally. India's annual requirements for these products were reported to be as follows:

	Tons
Canned vegetables, including tomatoes	6,000
Canned fruits	4,000
Jam and marmalade	4,000

Inasmuch as the preservation of these foodstuffs would conserve India's already inadequate supplies, and would effect an appreciable saving in shipping, the project appears worthy of serious consideration.

The Government of India reported to the Mission that its annual capacity for producing army service biscuits¹ was only 5,000 tons and that the annual demand of the armed forces was for 10,000 tons. It requested the assistance of the Mission in obtaining additional equipment with which to double its present biscuit-making capacity. If the capacity for the production of biscuits and bread should be appreciably increased, it might be necessary also to expand the capacity of flour mills in India to meet the increased demand of the bakeries for flour of the proper type. The Mission suggests that the Government of India may wish to investigate this possibility.

Recommendation.

1. Should it be requested by the Government of India, the Mission recommends that efforts be made to secure for India machinery and equipment necessary for the preservation of vegetables, fruits, jams, and marmalades as a measure for the conservation of both food and shipping.
2. The Mission strongly urges that the request of the Government of India for the equipment necessary to produce annually 5,000 tons of army service biscuits be promptly granted.

¹ The army service biscuit in India is made from heavy dough; when baked, it weighs 16 biscuits to the pound and is 3 inches by 2-3/4 inches by 5/16 inch in size.

EXPERTS AND TECHNICIANS FROM THE UNITED STATES

The recommendations made by the Mission are designed to increase the capacity and production of a number of Indian industries essential to the war effort. The implementation of these recommendations for the expansion of production will take three principal forms: (1) The erection of new plants, (2) the installation of additional equipment in existing plants, and (3) the re-arrangement of the machinery and equipment in existing plants. For this work the services of a number of experts and technicians will be required and India will be unable to provide all of the skilled personnel necessary to accomplish the task. The Government of India, therefore, requested the Mission to assist it in obtaining the services of several trained technicians and experts from the United States who, by virtue of their knowledge and experience, could act as temporary advisers on industrial production.

As a result of its investigations the Mission suggested to the Government of India that experts be sent from the United States to assist in solving the problems in transportation that have arisen because of the unusual burdens placed upon the railways and the congestion at west-coast ports.¹ Moreover, to stimulate industrial production, the Mission suggested that six production engineers from the United States be sent to India. These experts, acting as advisers to the Government of India, would be able to offer constructive suggestions for the improvement of plant arrangement of methods of production in privately owned factories and in those owned by the Government. The Government of India approved these suggestions and offered to make such experts its guests during their stay in India. The Mission, on its part, agreed to recommend that the salaries of these experts and their travelling expenses should be borne by the Government of the United States.

Because of plans to increase the production of essential war materials, officials of the Government of India have stated that, for special assignments, they would require the services of additional experts from the United States and requested the assistance of the Mission in obtaining them. The travelling expenses and salaries of all such experts would be paid by the Government of India. Officials of the Government asked for three technicians for the manufacture of machine tools who could supervise the programs of existing workshops, and who could teach and demonstrate production technique, it asked for two expert jig and tool makers and two expert jig and tool setters. It requested the services of an expert in the manufacture of tools, particularly shell tools, and for an expert in nonferrous metals who has training and experience in metallurgical work, including casting, drawing, and rolling. It also asked for two instrument makers skilled in the manufacture of surveying and other scientific instruments. These requests were endorsed by the Mission and a telegram was despatched to the Government of the United States asking that inquiries be made concerning the possibility of obtaining the services of such men.

Should other recommendations of the Mission be implemented, officials of the Government of India indicated that they would require additional expert assistance. Specific mention was made of experts for die casting, sulphur refining, coal-tar distillation, and the manufacture of record syringes and surgeons' gloves. Concerning these possible requests, the Mission agreed to render whatever assistance it could when the need should arise.

Officials of the Tata Iron and Steel Company asked the Mission while it was in Jamshedpur, to assist the company in obtaining from the United States the services of two production engineers. It is the plan of the company to make one of the engineers superintendent in charge of its railroad wheel, tire,

¹See Recommendations, section on Transportation and Communication.

and axle plant. The other engineer would advise the company concerning the operations of its machine shops, with a view to increasing their load and efficiency.

Recommendations.

1. The Mission recommends to the Government of the United States that experts be made available to advise the Government of India on problems pertaining to transportation and industrial production.
2. It agreed to assist the Government of India in obtaining from the United States various technicians and experts to assist in its program for the expansion of the production of essential war materials.
3. It agreed to assist the Government of India in obtaining additional expert assistance when specific needs should arise.
4. It further agreed to assist the Tata Iron and Steel Company in obtaining from the United States the services of two production engineers.

LABOR

The Government of India and some of the Indian States have inaugurated schools for the training of various types of technicians, ranging from chauffeur mechanics to machine-tool operators. In addition, several of the large factories have training programs for young and inexperienced employees. The Mission was impressed with the good quality and excellent potentialities of Indian labor. The Indian is skillful with his hands, and, given satisfactory working conditions with security of employment; is dependable and industrious.

In a number of plants visited by the Mission, workers who had never been in an industrial plant until recently were doing skilled work, and the labour turn-over was small. These plants are the exception rather than the rule, but the accomplishments there could be achieved elsewhere. Even in zones subject to air attacks, laborers have remained at their work. The Tata Iron and Steel Company is a good example. While some plants in and around Calcutta have been losing as high as 50 percent of their labor because of apprehension concerning hostilities, the Tata Company in an equally hazardous positions has had almost no loss. The flight of labor from the Calcutta area, where about 75 percent of war production is taking place, presents a serious current and future threat to sustained production. The Mission is not impressed by the argument of many industrialists that special wage bonuses in danger areas will stimulate, rather than diminish, the "flight from plant" because laborers will wish to spend these extra earnings in their home villages. The Tata Company and some other plants have had no such experience. The Tata Company has a system of bonuses and has acquired a 4 week's supply of food near the plants; it also has hostels and air shelters which give the workers a sense of security from the hazards of air attack. Workers are much the same the world over. They will respond favorably to good working conditions, security of employment, and opportunity for increased earnings.

The labor training program of the Department of Labor seems well conceived and ably directed. It is doubtful, however, that its present scope is adequate for the required expansion of industrial production in India. At least twice the present number of trainees would seem to be necessary. While training by the Department must be supplemented in the plants where the young men will be employed, it reduces the time of training that would other-

wise be required in the plants. The Mission feels strongly that plant training must also be greatly augmented. Plant managers are somewhat reluctant to make investment in training, but the experience of industrial countries like the United States demonstrates that sums spent for this purpose are fully justified from the standpoint of both the volume and cost of production.

The technical personnel which the Mission is seeking in the United States will aid in attaining the aims of the training program by the introduction of refinements in the technique of mass production. Trained personnel can usually increase its production if the ratio of machinery to manpower is also increased. Moreover, mass-production plants require less skill per unit of output than do jobbing plants.

The increased industrialization in India, whether for purposes of war or peace, and the effective training of labor, will be largely conditioned by the attitude of the Government and the industrialists toward wages and labor conditions. There must be a real incentive in increased earning power to induce young men to seek and accept training. Given the possibility of steadily increasing earnings, favorable working conditions, and adequate security, India will rapidly develop a body of skilled labor adequate for the expanding program of war production.

Recommendations.

1. The Mission recommends that the training program conducted by the Department of Labor of the Government of India and by some of the Indian States be expanded, as rapidly as possible, to at least twice their present size.
2. It recommends that the Government of India encourage the expansion of training programs in private industries and the inauguration of such programs in those industries which are not now conducting them.
3. It further recommends that the Government of India adopt a policy designed to enhance the earning power of labor, to improve its working conditions, and to provide increased security against both hostilities and unemployment.

Conclusion

In concluding this report, the Mission wishes to reemphasize its belief in the strategic importance of India to the cause of the United Nations. It desires again to call attention to India's great potentialities for industrial production because of its vast natural and human resources. The Mission feels that the utilization of the natural resources can be greatly developed and expanded, provided adequate tools are made available for that purpose, and it has seen evidence of the mechanical aptitude of Indian workmen who, given the proper incentives and working conditions, can become skilled craftsmen after a short period of training.

The American Technical Mission to India is strongly of the opinion that the prompt implementation of the recommendations contained in this report will not only strengthen the defense of India but will also permit that country to become a base for decisive offensive action against the enemy. It believes that India affords a unique opportunity to turn the tide of battle on the Eastern Front against the Axis Powers. It urges, therefore, that the most serious consideration be given to its recommendations by the Government of India, the United Kingdom, and the United States, in order that full advantage may be taken of the opportunity thus presented.

Sd: Henry F. Grady, Chairman

Sd: H. E. Beyster

Sd: Dirk Dekker

Sd: A. W. Herrington

Sd: Frank A. Waring, Executive officer.